Evaluation of an implementation intentions intervention for managing university student stress

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Abstract
University students consistently report high levels of stress, which has been associated with a range of adverse outcomes. Promoting adaptive coping behaviours, such as problem-focused coping for managing university stress, is therefore a timely area of investigation. Current coping intervention approaches target reasoned cognitive processes; however, recent research has suggested that automatic processes are more strongly associated with problem-focused coping behaviour. The current study examined the effect of an implementation intentions intervention, a technique that can support behaviour to be performed automatically by facilitating continued repetition of a plan, on problem-focused coping behaviour under stress and stress-related outcomes. Following a pilot study (N = 21), a preregistered randomized controlled trial was conducted with university students (N = 154) using an online survey. Participants completed baseline measures of problem-focused coping behaviour, behavioural automaticity, behavioural intentions, action planning, perceived stress, procrastination, and psychological wellbeing; before receiving the intervention or control condition stimuli, and then at a 2-week follow-up. Behavioural intention and action planning were also measured immediately post-intervention. The intervention had a significant medium-sized effect on action planning for problem-focused coping, but no other significant effects were detected. Exploratory assessment of plan quality revealed medium-sized correlations between plan quality and changes in problem-focused coping behaviour. Findings indicate that implementation intentions may be a promising approach for increasing planning for the use of problem-focused coping. Indicators of plan quality found to be associated with changes in problem-focused coping provide valuable avenues for intervention optimisation in future research.

KEYWORDS
automaticity, behaviour change, dual-process theories, planning, stress

Preregistration: https://osf.io/rfn7s/
University student populations report high levels of stress (Larcombe et al., 2016). Students report that their stress arises from a range of sources, including academic activities and the transition to university, finances, work, health-related concerns, interpersonal stressors, and family-related stressors (Pitt et al., 2018). Stress has been linked to lower psychological wellbeing (Cohen et al., 2016), and increased engagement in health and performance compromising behaviours such as procrastination (Sirois, 2023), alcohol consumption (Hamilton et al., 2013), and decreased exercise (Stults-Kolehmainen & Sinha, 2014). Further, research indicates that students do not typically seek professional help to manage stress (Casey, 2014). Therefore, researchers have attempted to increase students’ engagement in coping behaviours through the development of a range of intervention programs.

Commonly used interventions aiming to increase students’ engagement in specific coping behaviours include mindfulness-based stress reduction (MBSR), cognitive behavioural group programs, coping skills training, and psychoeducation. These interventions focus on increasing students’ engagement in adaptive coping behaviours, through participation in skill-building sessions and which commonly require participants to attend programs with substantive time commitments (e.g., 1–2.5 h per week over 4–12 weeks; Yusufov et al., 2019). Interventions such as MBSR and relaxation training focus on increasing emotion-focused coping strategies, to reduce the heightened arousal and associated feelings (Carver & Connor-Smith, 2010). In contrast, interventions such as tailored coping skills programs, can be applicable for increasing use of emotion-focused coping strategies or, for increasing problem focused coping (PFC) strategies such as planning, which aim to directly manage the stressors (Carver & Connor-Smith, 2010). Research indicates that PFC is a highly applicable coping strategy for university students, due to their most salient stressors being controllable and academic-related (Jensen et al., 2016; Pitt et al., 2018); and due to PFC having been linked to reduced perceived stress (Lai & Cheah, 2020), reduced procrastination (Shih, 2019), and increased psychological wellbeing (Chao, 2011) among university students. This is not to suggest that emotion-focused coping strategies are not potentially adaptive in the current context, but for the purposes of the current study, we have opted to focus on one shared coping behaviour to change, in a context where it would be widely considered to be adaptive.

A recent meta-analysis by Yusufov et al. (2019) investigated the efficacy of the current stress management interventions available for university students. The review examined studies utilising psychoeducation, MBSR, relaxation training, coping skills training, social support, and cognitive-behavioural based interventions. Overall, the findings indicated that the interventions consistently produced small to medium effects on perceived stress relative to controls; except for MBSR, which yielded no effect on perceived stress. A possible explanation for the findings is that the time requirements for the intervention was an additional demand for participants, leading to reduced engagement and therefore efficacy. Further, attending time-intensive sessions may be counterintuitive for students experiencing academic stress, as this is a directly modifiable stressor (Jensen et al., 2016; Pitt et al., 2018). The reviewed interventions also targeted reasoned cognitive processes, such as information provision and skill acquisition, to produce changes in coping behaviour. While targeting reasoned processes is clearly an important factor for promoting adaptive responses to stress, as evidenced by the interventions producing some positive impact (Yusufov et al., 2019), these interventions seek to change behaviour during periods of high cognitive load (i.e., when an individual is stressed). This may place a ceiling on their effectiveness as research indicates that when an individual is under stress, reasoned cognitive processes that rely on working memory are reduced (Banks & Boals, 2017; Otto et al., 2013). These types of intervention targets may also be vulnerable to the intention-behaviour gap, which refers to the discordance between intentions and the enactment of behaviour (Rhodes & de Brujin, 2013; Sheeran & Webb, 2016). Together, this suggests that future interventions aimed at promoting engagement in more adaptive coping behaviours should consider moving beyond targeting reasoned processes to consider volitional determinants of behaviour (Schwarzer, 2008), and automatic or habitual regulation of behaviour (Evans & Stanovich, 2013).

Dual process theories identify two interconnected cognitive processes that facilitate social cognition and behavioural regulation: reasoned and automatic processes (Evans & Stanovich, 2013; Strack & Deutsch, 2004). Reasoned processes rely on conscious thought and assist in hypothetical thinking, skill acquisition, problem-solving, and consequential decision making (Evans & Stanovich, 2013). Whereas automatic processes refer to the nonconscious automatic activation of previously learnt associations and behavioural schemata, which regulate behaviour without conscious deliberation (Evans & Stanovich, 2013; Strack & Deutsch, 2004). Based on previous research applying dual process theories to predicting coping behaviour and health behaviour (Keech & Hamilton, 2022; Phipps et al., 2020), this study conceptualised and measured reasoned processes as behavioural intentions, which refers to the extent to which an individual intends to perform a behaviour in the future (Ajzen, 1991); and automatic processes as behavioural automaticity, which reflects the extent to which a behaviour occurs automatically and is controlled by non-conscious processes (Gardner et al., 2012; Phipps et al., 2020).

Automatic processes have been found to have pervasive effects on a range of behaviours (Hagger, 2016). For example, a study conducted by Phipps et al. (2020) found support for automatic processes informing sugar restriction behaviour, as measured by behavioural automaticity. Specifically, behavioural automaticity predicted behaviour with effect sizes similar to reasoned processes, such as intentions. Further, Keech and Hamilton (2022) found that automatic processes predicted problem-focused coping behaviour with effects almost double the magnitude of those yielded by reasoned processes. Given that automatic processes tend to drive behaviour when there is high cognitive load (Banks & Boals, 2017; Evans & Stanovich, 2013; Strack & Deutsch, 2004), and they are not impacted by self-regulatory barriers like reasoned processes, interventions which are known to also influence automatic processes, such as
Implementation intentions, should be examined in the context of changing coping behaviour for the management of academic stress.

**Implementation intentions** are detailed ‘if-then’ action plans which target both automatic and reasoned processes (Gollwitzer & Sheeran, 2006). Reasoned processes are relied on to complete the action-plans, whereby individuals pre-determine the parameters for initiating their goal-directed behaviour by identifying the situational cue (i.e., “If situation X is encountered, then goal-directed behaviour Y will be initiated”). Identifying the contingency between the goal-directed behaviour and situational cue creates a mental link, which prompts the behaviour to occur via automatic processes when the situational cue is encountered (Aarts, et al., 1999; Gollwitzer, 1999; Webb & Sheeran, 2004).

Implementation intentions have effectively facilitated change for a range of behaviours such as eating more fruit with a medium meta-analytic effect size (Adriaanse, et al., 2011), increased physical exercise with a medium effect size (Robinson, et al., 2019), reduced binge-drinking with a small effect size (Norman, et al., 2019), and smoking cessation (Armitage, 2016; McWilliams, et al., 2019). Gollwitzer and Sheeran (2006) also reported a medium–large sized meta-analytic effect of implementation on goal attainment across behaviours. Implementation intentions have also been found to augment effects of psychoeducation for managing anxiety in a clinical sample with small–medium effect sizes (Varley, et al., 2011), and have been found and to assist with downregulating emotions such as disgust and sadness in the general population with a medium meta-analytic effect size when compared to goal intention instructions and a large meta-analytic effect size when compared to no instructions (Webb, et al., 2012). The consistency of findings across behaviours highlights robustness of the intervention in producing behaviour change and supports implementation intentions as effective in reducing the intention-behaviour gap.

However, not all implementation intentions are equal. There are key considerations which improve their effectiveness. For example, a study conducted by Carrera, et al. (2018) investigating the effect of implementation intentions increasing gym attendance did not find an effect. Comparing the findings to Robinson, et al. (2019), which also targeted exercise behaviour and found positive results, indicated that key factors in the design of the intervention must be considered when targeting habitual behaviours. Specifically, the intervention conducted by Carrera, et al. (2018) did not include a consistent situational cue for the behaviour, as participants could identify a different time on each day of the intervention to attend the gym. Robinson, et al. (2019), however, included personalised plans where participants identified where, when, and how they would increase their exercise. The differences in plan specificity and the ability to create personally relevant cues likely accounts for the differing findings, as de Vet, et al. (2011) found implementation intentions effects to correlate positively with the specificity of the plans. Therefore, interventions using implementation intentions should prompt participants to create highly specific personalised cues for the behaviour to ensure the situational cue is strong enough to overcome pre-established habits, such as procrastination in university students.

### 1.1 The present study

Applying dual process theory (Evans & Stanovich, 2013; Strack & Deutsch, 2004) to coping behaviour is supported by research which has found automatic processes to predict PFC behaviour more strongly than reasoned processes (Keech & Hamilton, 2022). Therefore, applying a behaviour change method known to target both automatic and reasoned processes, such as implementation intentions (Gollwitzer, 1999; Hamilton, et al., 2021), may prove effective in this context. The research was conducted in two phases. First, the implementation intentions intervention that was developed for the purposes of this study was pilot tested among members of the target population. Second, the effects of the intervention were evaluated in the main study. The following hypotheses were tested in the main study.

Building on previous research (Keech & Hamilton, 2022), and the tenets of the dual process theories of cognition and behaviour (Evans & Stanovich, 2013; Strack & Deutsch, 2004), the present study tested an implementation intention intervention, to increase students’ PFC behaviour for academic stress. First, it was hypothesised that participants allocated to the intervention condition would report significantly higher engagement in PFC behaviour ($H_3$), relative to participants allocated to the control condition from baseline to the follow-up 2 weeks later. With regard to the reasoned processes, it was hypothesised that participants allocated to the intervention condition would report significantly higher behavioural intention towards PFC ($H_4$), and significantly higher action planning for PFC ($H_5$), relative to participants allocated to the control condition from the baseline to (a) immediately post-intervention, and (b) the follow-up 2 weeks later. With regard to the automatic processes, it was hypothesised that participants allocated to the intervention condition would report significantly higher behavioural automaticity for PFC behaviour ($H_6$) relative to participants allocated to the control condition from baseline to the follow-up 2 weeks later. Turning to the secondary outcomes, as PFC is associated with higher psychological wellbeing (Chao, 2011), lower procrastination (Shih, 2019), and reduced perceived stress (Lai & Cheah, 2020); it was also hypothesised that participants allocated to the intervention condition would report significantly lower procrastination scores ($H_7$), lower perceived stress scores ($H_8$), and significantly higher psychological wellbeing scores ($H_9$), relative to participants allocated to the control condition from the baseline to the follow-up 2 weeks later.

### 2 PILOT STUDY

#### 2.1 Method

##### 2.1.1 Participants

Participants in the pilot study were young Australian university students ($N = 21$), ranging in age from 17 to 25 years ($M = 20.05$, $SD = 1.80$).
The majority of participants were studying full time and in their first year of university. A small proportion (14.3%) of the participants were from non-English speaking backgrounds. Detailed demographic characteristics are provided in Supplementary Appendix A. Inclusion criteria for participation included being aged 17–25 years and currently enrolled as an undergraduate university student. There were no exclusion criteria.

2.1.2 | Design and procedure

The pilot study used a qualitative design. Undergraduate university students aged 17–25 years were eligible to participate. Recruitment methods included online advertisements through email and a university research participant pool. An online survey tool (Qualtrics) was used to deliver the survey. Prior to commencing the survey, participants received study information and provided informed consent. Participants provided demographic information, completed the intervention task, and answered seven open-ended questions pertaining to intervention usability. The survey took approximately 15 min to complete. Course credit was assigned to participants enrolled in eligible courses. Data were collected in May 2020.

Intervention task
Participants first received information about PFC and that the goal is to increase PFC for university stress over the next 2 weeks. Participants were then prompted to identify an appropriate situation to employ the strategy with highly specific details to create the situational cue. An example implementation intentions plan was provided to prompt the creation of accurate and specific plans. Participants then typed plans for increasing PFC on the standard "if-then" implementation intentions template. The intervention as presented to participants is available on the Open Science Framework project website.

2.1.3 | Measures

Demographic characteristics
Demographic questions included gender, age, student type, year of study, study load, English to speakers of other languages, country of origin, ethnicity, weekly working hours, occupation, employment status, annual income, parental status, as presented in Supplementary Appendix A.

Feedback questions
Seven open-ended questions were included to determine the overall experience, clarity, realistic impact, and perceived influence of the intervention within the target population. Sample Item: (e.g., "If you are comfortable, please share how well you were able to complete the task."). The survey questions as presented to the participants can be viewed on the Open Science Framework project website.

2.1.4 | Data analysis

Data were analysed using content analysis, to identify revisions required to enhance comprehension of the intervention task. Responses to the questions, in addition to the quality and relevance of the implementation intentions plan, were analysed.

3 | RESULTS AND DISCUSSION

The pilot study was conducted to determine the feasibility of the intervention task and to identify any required modifications. Results from the qualitative content analysis indicated that 85.7% (n = 18) of participants found the intervention task easy to complete, 90.5% (n = 19) agreed that PFC is a realistic coping strategy for academic stress, and 85.7% (n = 18) identified the intervention directly informed how they would cope with academic stress over the following week. Only 4.8% (n = 1) highlighted clarity issues; however, as this participant completed the intervention task correctly and had contradictory responses on other items, the response was deemed an error. Further, 71.4% (n = 15) of participants stated the intervention task did not require any revisions, and those participants who did suggest revisions (n = 3) provided suggestions which were already included in the main study (e.g., "add multiple-choice questions"). Participants not included in the results responded with “n/a" or did not answer the question. Overall, the findings indicated acceptable comprehension and applicability among the target population. Therefore, no modifications to the intervention task were deemed necessary prior to the main study.

4 | MAIN STUDY

4.1 | Method

4.1.1 | Participants

Participants were young undergraduate university students (N = 154; 81% female), ranging in age from 17 to 25 years (control group M = 20.87, SD = 1.81; intervention group M = 20.84, SD = 2.09). The majority of participants were Australian domestic university students studying full time and in their first 4 years of studying. See Supplementary Appendix A for detailed demographic characteristics. Inclusion criteria for participation included being aged 17–25 years and currently enrolled as an undergraduate university student. There were no exclusion criteria.

4.1.2 | Design

The study was a randomized controlled trial which adopted a double-blinded mixed within-between experimental design. Participants were blinded in that they were not aware of the experimental
condition in which they were assigned, or that different participants could be assigned to different conditions. Experimenter blinding was facilitated by online intervention delivery whereby the Qualtrics online survey software randomly assigned participants to groups without researcher involvement. The Qualtrics randomiser is embedded within the survey and operates without experimenter involvement. This is a simple randomisation procedure based on a Mersenne Twister pseudorandom number generator which is seeded using a Unix timestamp (in milliseconds). The research team was not aware of participant assignment to groups until the study had concluded and the data were being prepared for analysis. Group (control or experimental) and time (baseline, immediately post-intervention [for measures of intention and action planning], 2 weeks post-intervention) were independent variables. The primary outcome variables were PFC behaviour intensity and frequency, behavioural intention, action planning, and behavioural automaticity (all referenced to PFC behaviour). The secondary outcome variables were procrastination, psychological wellbeing, and perceived stress.

4.1.3 Measures

Demographic measures
Demographic measures were administered consistent with the Pilot Study.

Primary outcomes
The primary outcomes of PFC behaviour, behavioural automaticity, behavioural intention, and action planning were measured via self-reported measures that were developed based on established guidelines and that have been administered in student samples (Ajzen, 2006; Keech & Hamilton, 2022; Verplanken & Orbell, 2003). Each measure made explicit reference to the target behaviour of PFC behaviour to allow for accurate responding. Participants responded to the items on Likert scales. Measures were taken at baseline, immediately post-intervention (intention and action planning only), and at the 2-week follow-up. See Supplementary Appendix B for survey questions.

Secondary outcomes
Participants completed self-report measures of procrastination (Tuckman Procrastination Scale; Tuckman, 1991), perceived stress (Perceived Stress Scale-10, Cohen et al., 1983), and psychological wellbeing (Warwick-Edinburgh Mental Wellbeing Scale-14; Tennant et al., 2007) referenced to the previous 2 weeks at baseline and at the 2-week follow-up.

Data quality
Two questions were used to detect inattentive responding (Maniaci & Rogge, 2014; Schroder et al., 2016). Participants who did not answer both questions correctly were excluded prior to data analysis.

4.1.4 Procedure

An a priori power analysis was conducted using G*Power v3.1 (Faul et al., 2007) for a 2 × 2 mixed model analysis of variance (ANOVA) estimating within-between interactions. Based on a medium effect (f = 0.25), power set to 0.95, and α = 0.01 (adjusted to protect from inflation of Type I error rate due to multiple tests being conducted), the analysis indicated the total minimum sample size required at the follow-up was n = 90 participants (n = 45 participants in each condition). To allow for an attrition rate of 40%, the target sample size at baseline was 150. A pre-registered stopping rule was used to determine when to cease recruitment.

The study was preregistered prior to data collection on the Open Science Framework. There were no deviations from the preregistered protocol. The University of the Sunshine Coast Human Research Ethics Committee approved the study (reference: S102408). Undergraduate university students aged 17–25 years were eligible to participate. Recruitment methods included online advertisements through social media (i.e., Facebook), email, student newsletters, and a university participant pool. Students enroled in eligible courses could opt to receive course credit.

An online survey tool (Qualtrics) was used to deliver two surveys to participants. During the initial survey, participants received information about the study requirements, provided informed consent, demographic information, and completed pre-intervention (baseline) measures of the study variables. Following completion of the pre-intervention survey, participants were randomized into one of the two groups (experimental or control) by the Qualtrics randomiser feature. Participants completed the surveys and intervention online at a time of their convenience, without an experimenter present. The follow-up survey was identical to the pre-intervention survey. See Figure 1 for study design. Participants received an email and short message service (SMS) text message as a prompt to complete the follow-up survey 2 weeks after receiving the intervention. Participants then received up to two SMS text message reminders to minimise attrition. Data were collected between May and September 2020. Stay at home lockdown orders related to the novel coronavirus disease 2019 (COVID-19) pandemic were lifted in the region in which the data were collected on 1 May 2020, which was prior to commencement of data collection for this study.

No further lockdown orders were imposed during the study period, but some restrictions remained in place (limits on travel distance from home; limits on gathering sizes; limits on occupancy of businesses). Please see Supplementary Appendix C for CONSORT flowchart.

Control condition
Participants in the control group received information about PFC and that the goal is to increase PFC for university stress over the next 2 weeks. Participants were invited to complete a follow-up survey 2 weeks after the baseline was completed.
Intervention condition

Participants in the intervention group completed the intervention task, as described in the Pilot Study Method and shown as presented to participants on the Open Science Framework project website. This involved receiving information about PFC and that the goal is to increase PFC for university stress over the next 2 weeks (consistent with the information provided to the control group). This was followed by being prompted to identify an appropriate situation to employ the strategy with highly specific details to create the situational cue. Participants were then provided with an example implementation intentions plan and instructed to type out an implementation intentions plan for increasing PFC on the standard “if-then” implementation intentions template. This methodology was designed to allow the experiment to examine the potential additive effect of using implementation intentions for changing coping behaviour, over and above just receiving information about coping.

4.1.5 | Data analysis

The effect of the intervention on engagement in PFC (frequency and intensity), behavioural automaticity, procrastination, psychological wellbeing, and perceived stress was evaluated using 2 × 2 mixed model ANOVAs in IBM Statistical Package for the Social Sciences (SPSS) v.26. Group (experimental or control) was the between-participants independent variable; and time (T1 pre-intervention, T2 2-week follow-up) was the within-participants variable. The effect of the intervention on behavioural intention and action planning was evaluated using two 2 × 3 mixed model ANOVAs with group as the between-participants variable and time (T1 pre-intervention, T2 post-intervention, T3 2-week follow-up) as the within-participants variable. Each outcome was a separate dependent variable in a separate ANOVA. The alpha level in each ANOVA was adjusted to α = 0.01 to protect from inflation of type I error rate due to multiple tests. Where an ANOVA indicated a significant Time × Group interaction for any of the dependent variables, simple effects analyses using estimated marginal means were examined for that outcome. Specifically, within-participants differences in the outcome between time points, and between-group differences in the outcome at each time point were compared. Effect sizes were interpreted using Cohen’s (1988) guidelines where a $\eta^2_p$ of 0.01, 0.06, and 0.14 were considered indicative of small, medium, and large effects, respectively.

4.2 | Results

4.2.1 | Preliminary analyses

Aside from the participants who did not complete the follow-up survey (30 control group participants and 22 intervention group participants; 33.8% attrition), and the 6 cases who were excluded due to not passing the data quality check questions, the extent of missing data on the study variables is as follows: 7 cases missing (6 control; 1 intervention) for psychological wellbeing at the follow-up; 6 cases missing for perceived stress (5 control; 1 intervention); 4 intervention group cases missing for action planning measured immediately post-intervention; 4 intervention group cases missing for intention measured immediately post-intervention; and 2 intervention group cases missing for procrastination at the follow-up. Results of Little’s test for the intervention group, $\chi^2 (26, N = 67) = 25.45, p = 0.494$ and control group, $\chi^2 (66, N = 87) = 71.44, p = 0.302$, indicated that data were missing completely at random. The expectation maximisation (E-M) algorithm was used to impute missing data based on Enders’ (2010) recommendations. All reported analyses are based on the E-M imputed dataset. Independent groups t-tests revealed that there were no significant differences on any of the baseline study variables for those lost to attrition compared with those who completed both surveys (p > 0.05). While it was not possible to control exposure to stress among the sample (i.e., by having participants within a single...
course all participate at the same time), baseline perceived stress scores indicate that on average the participants were experiencing levels of stress which were greater than moderate scores of 14 (PSS-10 Baseline M_control = 22.74, M_intervention = 21.99) and substantively higher than population norms (Cohen et al., 1983).

Examination of univariate skewness (ratio of skew to SE > 3.29) and univariate kurtosis (ratio of kurtosis to SE > 3.29) indicated that the normality assumption was met for all outcomes. Two univariate outliers were detected in initial data screening (z > ±3.29) and a further six multivariate outliers were detected using Mahalanobis’ distance. All analyses were run with outliers included and outliers excluded. Because exclusion of outliers did not result in any inferential changes and because they are likely true scores, all cases were included in the reported analyses. The Huynh-Feldt estimate was applied for the analyses with action planning as the outcome to correct for sphericity. Mauchly’s test yielded a non-significant result for all other analyses and therefore the assumption of sphericity was met.

4.2.2 | Primary outcomes

Estimated marginal means, standard errors, and 99% confidence intervals of study variables by time and group are reported in Table 1. Estimated marginal means and confidence intervals are graphically displayed in Appendix D. There were no significant differences between groups at the baseline for any of the primary outcomes.2

A mixed model ANOVA revealed no significant Time × Group interaction effect on intensity of engagement in PFC F (1, 152) = 0.13, p = 0.719, ηp² = 0.00; frequency of engagement in PFC F (1, 152) = 0.11, p = 0.738, ηp² = 0.00; behavioural automatity for PFC F (1, 152) = 2.23, p = 0.072, ηp² = 0.02; or intention to use PFC, F (2, 304) = 2.14, p = 0.120, ηp² = 0.01. This indicates that the intervention did not result in any statistically significant changes in engagement in PFC, behavioural automatity, and behavioural intentions. Effect sizes were also consistently small. Therefore, Hypotheses 1, 2, and 4 were rejected.

A mixed model ANOVA revealed a statistically significant Time × Group interaction effect on action planning, with a medium effect size, F (2, 304) = 6.78, p = 0.002, ηp² = 0.04, displayed in Figure 2. This indicates that differences in action planning across time points were not equivalent between groups, providing support for Hypothesis 3. To probe the interaction effect, simple effects were examined. The control group did not change significantly over time. Action planning was significantly higher for the intervention group compared to the control group immediately post-intervention (p < 0.001, ηp² = 0.15), and at the 2-week follow-up (p = 0.006, ηp² = 0.05). Therefore, Hypotheses 3a and 3b were supported.

4.2.3 | Secondary outcomes

Mixed model ANOVAs revealed no statistically significant Time × Group interaction effects on perceived stress, F (1, 152) = 0.67, p = 0.414, ηp² = 0.00; psychological wellbeing, F (1, 152) = 0.62, p = 0.443, ηp² = 0.00; or procrastination F (1, 152) = 0.07, p = 0.795, ηp² = 0.00. Effect sizes were also consistently small, as graphically displayed in Appendix D and Appendix E. Therefore,

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Intervention</th>
<th>Follow-up</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of engagement in PFC behaviour</td>
<td>4.55 0.18 [4.08, 5.03]</td>
<td>4.31 0.21 [3.77, 4.85]</td>
<td>4.47 0.16 [4.05, 4.88]</td>
<td>4.32 0.18 [3.85, 4.80]</td>
<td></td>
</tr>
<tr>
<td>Intensity of engagement in PFC behaviour</td>
<td>4.35 0.18 [3.88, 4.81]</td>
<td>4.28 0.20 [3.75, 4.81]</td>
<td>4.39 0.15 [3.99, 4.79]</td>
<td>4.23 0.17 [3.78, 4.68]</td>
<td></td>
</tr>
<tr>
<td>Behavioural automaticity</td>
<td>4.26 0.18 [3.79, 4.72]</td>
<td>3.99 0.20 [3.46, 4.52]</td>
<td>4.39 0.14 [4.02, 4.76]</td>
<td>3.77 0.16 [3.35, 4.20]</td>
<td></td>
</tr>
<tr>
<td>Behavioural intention</td>
<td>5.27 0.12 [4.96, 5.57]</td>
<td>5.44 0.13 [5.10, 5.79]</td>
<td>5.47 0.10 [5.21, 5.73]</td>
<td>5.44 0.12 [5.14, 5.74]</td>
<td></td>
</tr>
<tr>
<td>Action planning</td>
<td>3.72 0.18 [3.25, 4.19]</td>
<td>4.10 0.21 [3.57, 4.64]</td>
<td>4.04 0.16 [3.63, 4.43]</td>
<td>4.71 0.18 [4.24, 5.17]</td>
<td></td>
</tr>
<tr>
<td>Perceived stress</td>
<td>22.74 0.79 [20.68, 24.80]</td>
<td>21.99 0.90 [19.64, 24.33]</td>
<td>20.17 0.80 [18.08, 22.26]</td>
<td>20.21 0.91 [17.83, 22.59]</td>
<td></td>
</tr>
<tr>
<td>Procrastination</td>
<td>2.41 0.07 [2.23, 2.59]</td>
<td>2.27 0.08 [2.07, 2.48]</td>
<td>2.46 0.07 [2.29, 2.63]</td>
<td>2.32 0.07 [2.12, 2.51]</td>
<td></td>
</tr>
<tr>
<td>Psychological wellbeing</td>
<td>41.75 0.97 [39.23, 44.27]</td>
<td>43.57 1.10 [40.70, 46.44]</td>
<td>42.64 1.00 [40.04, 45.24]</td>
<td>45.22 1.14 [42.26, 48.18]</td>
<td></td>
</tr>
</tbody>
</table>

Note: Follow-up scores were taken at the 2-week follow-up post-intervention. Behavioural intention was also measured immediately post-intervention (Control: M = 5.44, SE = 0.11, 99% CI [5.16, 5.72]; Intervention: M = 5.68, SE = 0.12, [5.36, 6.00]). Action planning was also measured immediately post-intervention (Control: M = 4.00 SE = 0.16, 99% CI [3.58, 4.43]; Intervention: M = 5.28, SE = 0.19, [4.79, 5.76]). Participants excluded due to failing attention check questions (n = 6) are not included in estimates. Estimates are based on imputed data results. Control group n = 87; Intervention n = 67. Abbreviation: CI, confidence interval.
Hypotheses 5–7 were rejected. There were no significant differences between groups at the baseline for any of the secondary outcomes.3

Due to the possibility that the heterogeneity of the sample was having a confounding influence on the results, for completeness we repeated all pre-registered analyses using analysis of covariance (ANCOVA), with gender and year of study as covariates. All results yielded consistent inferences with the pre-registered analyses.

4.2.4 Exploratory analysis of plan quality

Following the initial data analysis, the implementation intention plans developed by participants in the intervention group were coded to quantify the quality of each plan. The purpose of examining plan quality was to develop an understanding of which components of the implementation intentions were done well by participants and whether the content of the plan was associated with changes in the outcome variables among intervention group participants. The coding scheme was adapted for the current context based on de Vet et al. (2011). Specifically, we utilised the concept of measuring the specificity of the implementation intention plans created by participants by coding the plans based on how accurately they described the start time, duration, and activity they would be implementing (see Appendix F for the coding scheme). See Supplementary Appendix G for frequencies and percentages for the plan quality indicators. Results indicated that the majority of intervention group participants identified a specific situation (85%), a specific PFC behaviour (88%), a goal relevant to PFC (54%), or a goal relevant to stress (55%) in their implementation intentions plan. A smaller number of participants identified a specific start time (10%; however, 78% had an implied immediate start time) or duration (12%). Identification of a specific situation in the plan was positively correlated with change in PFC frequency between baseline and the follow-up \( r (65) = 0.30, p = 0.013 \); and intention to use PFC between baseline and post-intervention \( r (65) = 0.27, p = 0.028 \). No other plan quality indicators yielded significant associations with changes in outcome variables (See Supplementary Appendix H for correlations between plan quality and difference scores for study variables for the intervention group).

5 DISCUSSION

The aim of the current study was to determine whether implementation intentions are an effective behaviour change method for promoting PFC behaviour for academic stress. The study also aimed to evaluate the effect of the intervention on behavioural automaticity, behavioural intention, and action planning for engagement in PFC; as well as procrastination, perceived stress, and psychological wellbeing. Results indicated that the intervention did not have a significant effect on intensity or frequency of engagement in PFC behaviour, or on behavioural intention for PFC. Therefore, H1 and H2 were rejected. An effect was observed for action planning immediately post-intervention and at the 2-week follow-up. This provided support for H3a and H3b. Contrary to expectations, no changes in behavioural automaticity, or any of the secondary outcomes were observed. Therefore H4–H7 were rejected.

The findings that the intervention did not significantly increase frequency or intensity of engagement in PFC behaviour contrasts with previous findings that implementation intentions effectively facilitate changes in goal-directed behaviour (Armitage, 2016; Gollwitzer & Sheeran, 2006). In contrast to the second hypothesis, findings indicate that completion of the implementation intentions intervention did not significantly increase intention to utilise PFC behaviour for academic stress, and participants reported moderate to high intentions at all time points. While trends in the predicted directions were observed immediately post-intervention, scores regressed back towards baseline levels at the 2-week follow-up. A
The third hypothesis that the intervention task would increase action planning was supported. Specifically, an effect was detected immediately post-intervention and at the 2-week follow-up, indicating the intervention task successfully facilitated and maintained planning of PFC behaviour for academic stress. This is an important finding, as it is the first evidence suggesting that implementation intentions can be used to target a process which may help individuals to enact their desired coping behaviour for managing academic stress. This is because planning is known to reduce the intention-behaviour gap. While action planning for PFC remained significantly higher at the follow up, the strength of the effect had started to decline. Considering the theoretical foundations of implementation intentions plans (Gollwitzer, 1999), a possible explanation is that the intervention relied on retrospective recall of the plan, prior to the establishment of a strong mental link. In the context of implementation intentions, a mental link refers to the cognitive association between the intended goal behaviour and the situational cue (Gollwitzer, 1999). Therefore, these findings indicate that participants may have required additional exposure to their plans in order for action planning to be maintained over the 2 weeks. Given that implementation intentions are a planning-based intervention, declining salience of the plan may explain the lack of observed effects. In contrast to expectations, no effect of the intervention was observed for the secondary outcomes of procrastination, perceived stress, or psychological wellbeing. A possible explanation for these findings is that the lack of an observed increase in PFC engagement means that changes in these secondary outcomes would be unlikely to occur. Specifically, if participants’ maladaptive coping behaviours such as procrastination were maintained, the theoretical conditions for improvements in these outcomes would not exist. Beyond this, the measures may not have accurately detected the outcome changes due to relying on retrospective recall, which is known to be susceptible to bias (Colombo et al., 2020).

5.1 Study strengths and limitations

The current study had several strengths. First, the novel application of an implementation intentions intervention for student academic stress was grounded in theoretically mapped behaviour change methods. Second, the intervention underwent rigorous pilot testing. Third, the study used a preregistered double-blind randomized controlled trial design to minimise potential confounds and to freeze a priori hypotheses that were derived prior to data collection. Fourth, the study examined associations between several facets of plan quality and changes in the study outcomes.

The current study also has limitations which need to be considered. First, the study was conducted on a somewhat heterogeneous group of students, with various levels of study experience, who were studying different courses, and hence may have been experiencing different levels of study-related stress. While we expected that random allocation to groups would help to mitigate the impact of this, and there was no significant difference in perceived stress between groups at the baseline, it is possible that these factors created increased variability in the effects of the intervention. For example, students with more study experience may have stronger pre-established habits for coping with academic stress and this could hinder the development of the new behaviour. Future research should target a more homogeneous student group, such as first year university students enroled in the same course, and then aim to conduct the intervention at the same time-point in the semester for all participants. Females were also overrepresented in the sample, and therefore, caution is required when generalising the results to males. The study also relied on retrospective recall for all measures, which is known to be affected by recall accuracy limitations (Colombo et al., 2020). The effect of the intervention may have also decreased over time. Therefore, future research should seek to measure behaviour more regularly over a longer period of time and should consider whether booster sessions are needed to promote long-term change. Finally, participants were recruited knowing that they were participating in a programme to assist them with managing stress. Future research should therefore seek to overcome potential limitations associated with demand characteristics and social desirability.
5.2 | Implications for future research and practice

The results of the current study provide preliminary support for the use of implementation intentions in the context of planning to change coping behaviours. However, the lack of effects detected on outcome variables other than action planning raise the possibility that implementation intentions may be limited in utility in the current context, or that there may be very specific circumstances under which they have potential to be effective for changing coping behaviour. Therefore, further advances and refinements to the intervention are required prior to practical implementation of this strategy. Further, the findings based on an analysis of plan quality indicate that the identification of a specific start time (i.e., knowing when to enact the plan) and duration were rarely made, and this is an important consideration for improving the efficacy of the intervention. These differences in plan quality may also be attributable to individual differences in if-then planning whereby some individuals spontaneously make detailed plans in their daily life without intervention (Bieleke & Keller, 2021). Therefore, future research utilising implementation intentions for coping behaviour should consider including a self-review procedure where participants are prompted to check they have included specific detail regarding when to initiate their plan and the duration of enactment. An additional consideration is that creating multiple implementation intention plans may prompt participants to think more critically about the different scenarios that elicit academic stress and may lead to increased specificity of plans. This may allow for increased detection of the situational cue to engage in PFC.

The findings suggest that participants may also require additional exposure to their implementation intention plans while establishing the mental link between academic stress and PFC. Previous research has found boosters are effective in assisting with the maintenance of behaviour change (Fleig et al., 2013; Pirolli et al., 2017). Booster sessions are brief additional contacts beyond the main intervention which help to reinforce previous content (Fjeldsoe et al., 2011). For example, a study conducted by Chapman and Armitage (2010) found that adding booster sessions increased adherence to fruit and vegetable consumption compared to single-session interventions. The present study had a strong rationale for using a single planning session, given that this was the first test of an implementation intentions intervention for problem-focused coping behaviour, and that single sessions have been found to be effective across several studies (e.g., Armitage, 2004; de Noojier et al., 2006). Given that the strength of the effect on action planning had started to decline at the follow-up in the current study, future studies should consider including and evaluating the potential benefit of booster sessions. An alternative to scheduling additional sessions could be prompting participants to review their plans throughout the intervention period. This could be executed by sending participants a message containing their completed plans immediately after the intervention and at specified times during the intervention period. This refinement to the design may enhance results two-fold, by reducing the memory decay of plans and by providing an additional situational cue for participants to implement their plan.

There is currently limited research providing insight into the ideal follow-up period for observing whether implementation intentions are effective in establishing maintained behavioural change. The rationale for specifying a 2-week follow-up in the current study was to allow students enough time to experience the situational cue of academic stress and opportunities to implement PFC behaviour, while also remaining brief enough to maintain accuracy of behavioural recall. However, it is possible that the duration of the follow-up period may not have been long enough to allow for PFC behaviour to become automatic, due to the complex self-regulatory processes involved in PFC and possible interference with pre-established habits of procrastination. Research indicates that habit formation can take from 18 to 254 days to reach peak automaticity (Lally et al., 2010). This highlights the need for future research to consider implementing an intensive longitudinal design or daily diary method to encapsulate a more accurate indication of the development of automated behaviour (e.g., Bolger & Laurenceau, 2013), following implementation intention interventions for coping behaviour.

Examining the use of implementation intentions for increasing engagement in PFC is an initial step in progressing our understanding of the use of behaviour change methods for changing coping behaviour. However, it must be considered that emotion-focused strategies can also be adaptive in these contexts, and some students may prefer to use such approaches in some contexts. Therefore, future research could also consider testing the effect of the implementation intentions intervention for increasing forms of emotion-focused coping.

6 | CONCLUSION

The current study was the first to explore the efficacy of an implementation intentions intervention as a strategy for increasing engagement in PFC for academic stressors. Results revealed that the intervention had an effect on action planning for increasing PFC behaviours immediately post-intervention and at the 2-week follow-up. Contrary to expectations, the intervention did not have an effect on the engagement in PFC behaviour or on behavioural automaticity for PFC, behavioural intention to engage in PFC, or any secondary outcomes including procrastination, perceived stress, or psychological wellbeing. The intervention appears to be effective in initiating and maintaining action planning for PFC behaviour, which is important due to the role of planning in the establishment of routines and habits. Further, exploratory analyses revealed that participants who identified specific situations to enact their PFC activity had increased intentions to use PFC and engagement in PFC, highlighting the fundamental importance of specifying the situational cue when completing the intervention task. Future studies should modify the study design to reduce the impact of potential declines in memory retention of the plan, by incorporating booster intervention sessions. To better understand the role of implementation intentions in changing coping behaviours for academic stress, future research should also employ an intensive longitudinal design to measuring relevant constructs prior to and following the intervention. Overall,
findings indicate that implementation intentions plans should continue to be investigated as a behaviour change intervention for promoting more adaptive coping behaviours in highly stressed groups.

**AUTHOR CONTRIBUTIONS**

Leah J. Rackemann: Conceptualisation; methodology; data collection; data analysis; writing – original draft; writing – review and editing.

Kyra Hamilton: Conceptualisation; methodology; writing – review and editing.

Jacob J. Keech: Conceptualisation; methodology; data curation; data analysis; writing – original draft; writing – review and editing; supervision.

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**CONFLICT OF INTEREST STATEMENT**

The authors have no known conflicts of interest.

**DATA AVAILABILITY STATEMENT**

Data, analysis scripts, analysis output, and materials are available at [https://osf.io/afn4j/](https://osf.io/afn4j/).

**ETHICS STATEMENT**

The University of the Sunshine Coast Human Research Ethics Committee approved this research (reference: S102408).

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**ENDNOTES**

1 Recruitment continued until the baseline target sample size of 150 participants had been reached. Once this target sample size was reached, online recruitment ceased, and the baseline survey was closed so that no further participants could sign-up. Data collection continued until all participants already signed-up had participated in the follow-up survey.

2 There were no significant differences between the control and intervention groups at baseline for any of the primary outcomes, including intensity of PFC engagement (p = 0.821, η² = 0.00); frequency of PFC engagement (p = 0.389, η² = 0.01); behavioural automaticity (p = 0.322, η² = 0.01); behavioural intention (p = 0.318, η² = 0.01); or action planning (p = 0.165, η² = 0.01).

3 There were no significant differences between the control and intervention groups at baseline for any of the secondary outcomes, including perceived stress (p = 0.531, η² = 0.00); psychological wellbeing (p = 0.216, η² = 0.01); and procrastination (p = 0.200, η² = 0.01).

**REFERENCES**


**SUPPORTING INFORMATION**

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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