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Examining the Influence of Savoring Interventions on Positive Emotions in University Students: A Systematic Review and Meta-Analysis

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Abstract

In higher education, enhancing positive experiences for university students is a top priority. Savoring interventions have been extensively researched to help individuals in experiencing and amplifying specific positive emotions (PEs) within this educational context. The objective of this study is to investigate the overall impact of savoring interventions on PEs of university students. It also aims to determine the effectiveness of different categories of savoring interventions in achieving the desired outcomes. A comprehensive search was performed across multiple databases. A total of 14 studies were included in this study. The findings indicate that a variety of savoring interventions had significant and positive effects on students' PEs, with a combined effect size of 0.706 ($p < 0.001$). Specifically, past-focused savoring interventions demonstrated the highest mean effect size ($ES = 0.748$, $p < 0.001$) compared to present-focused ($ES = 0.700$, $p = 0.05$) and future-focused ($ES = 0.735$, $p < 0.001$) interventions. The findings demonstrate a noteworthy positive effect of savoring interventions on PEs in university students. Moreover, the results suggest that past-focused savoring interventions are more effective in enhancing PEs among university students compared to both present and future-focused interventions.

Keywords: intervention, positive emotions, savoring interventions, university students

1. Introduction

PEs play a crucial role in the psychological well-being, happiness, resilience, and success of individuals (Casino-García et al., 2019; Dreer, 2021; Fredrickson, 2001). This significance becomes even more pronounced in the context of university students who face numerous challenges and demands associated with higher education (Besser et al., 2022; Pekrun et al., 2002). For instance, in 2019, the World Health Organization conducted an online survey of first-year students from 19 universities in 8 countries worldwide and found that over 30% of university students reported experiencing at least one mental disorder in the past 12 months (Auerbach et al., 2019). PEs not only contribute to students' overall well-being but also shape their academic performance, motivation, and relationships with others (Datu et al., 2019; Linnenbrink-Garcia & Pekrun, 2011). Furthermore, PEs facilitate the development of a positive mindset, optimism, and resilience, enabling students to effectively cope with academic and personal obstacles (Datu et al., 2019; Fredrickson, 2001; MacIntyre et al., 2019). They also promote academic motivation and engagement by fostering intrinsic motivation, curiosity, and a sense of mastery (Fredrickson, 2001; Linnenbrink-Garcia & Pekrun, 2011). Recognizing the multifaceted nature of PEs and their implications in higher education is essential for creating supportive learning environments that foster students' holistic development (Meyer et al., 2018).

In recent years, positive psychology interventions have garnered significant attention as a means of enhancing individuals' well-being and PEs (Brunzell et al., 2016; Fredrickson, 2001; Shoshani & Slone, 2017). These interventions have shown promise across various populations, including university students who often face unique challenges and stressors during their academic journey. Among the different types of positive psychology

interventions, savoring interventions involve consciously focusing on and fully experiencing PEs, events, or moments in life (Borelli et al., 2022; Brunzell et al., 2016; Zhao et al., 2019). They encourage individuals to immerse themselves in the present, appreciate positive experiences, and develop a positive perspective. By incorporating past, present, and future orientations, savoring interventions provide a holistic approach to embracing positive experiences (Appiah, 2022). They allow individuals to reflect on and savor positive memories, engage with PEs in the present, and anticipate positive possibilities in the future. The savoring strategies primarily employed can be categorized into two types. The first type is behavioral strategies, which include sharing with others, absorption, and behavioral expression. The second type is cognitive strategies, which include comparing, sensory-perceptual, sharpening, memory building, self-congratulation, temporal awareness, counting blessings, and avoiding kill-joy thinking (Bryant, 2021). By practicing savoring, individuals can increase their overall well-being, happiness, and develop a more positive outlook on life (Bryant et al., 2011; Jiang et al., 2022; Smith et al., 2014). However, despite the growing interest in the impact of savoring interventions on PEs in university students, there is inconsistency in the findings across different research studies. These studies have examined the effects of savoring interventions on PEs in university students, aiming to improve their overall well-being and emotional experiences (Hurley & Kwon, 2012; Klibert et al., 2022). However, due to variations in methodology, sample characteristics, or measurement tools used, the results have been inconclusive and conflicting. This inconsistency in findings highlights the need for further investigation to address this research gap.

To bridge this research gap and reconcile the inconsistent findings, a meta-analysis is proposed as a valuable approach. A meta-analysis involves a systematic review and statistical synthesis of data from multiple independent studies (Littell et al., 2008). By aggregating the findings of these studies, a meta-analysis provides a comprehensive and unbiased summary of the available evidence, enabling a more robust assessment of the influence of savoring interventions on PEs in university students. Conducting a meta-analysis allows researchers to overcome the limitations of individual studies, such as small sample sizes or varying methodologies (Gurevitch et al., 2018). The pooled data from multiple studies provide a larger sample size, enhancing statistical power and the generalizability of the findings. Moreover, a meta-analysis allows for the exploration of potential moderators and sources of heterogeneity, such as intervention duration, study design, or participant characteristics, which may have contributed to the inconsistent findings in previous research (Hickin et al., 2021).

Therefore, the objective of this study is to conduct a meta-analysis to comprehensively examine the influence of savoring interventions on PEs in university students. Specifically, on the one hand, the aim is to reconcile the inconsistent findings observed in various research studies on this topic and examine the overall impact of savoring interventions on the PEs of university students. On the other hand, the study aims to determine the effectiveness of different categories of savoring interventions, including past-focused, present-focused, and future-focused interventions, on the PEs of university students. By achieving these objectives, the meta-analysis aims to contribute to the existing literature by providing a comprehensive and robust understanding of the influence of savoring interventions on PEs in university students. The findings of this study can inform evidence-based interventions, guide future research efforts, and promote the well-being and academic success of university students.

2. Method

The reviewers of the study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a rigorous and transparent review process (Shamseer et al., 2015). To conduct their review, the reviewers registered their review protocol on Inplasy.com (INPLASY202370053). This registration helps to enhance the transparency and credibility of the review process by providing a clear record of the planned methods and objectives. The reviewers systematically conducted an extensive search of scholarly literature by utilizing four prominent electronic databases, namely Web of Science, Scopus, PubMed, and PsycINFO. These databases encompass a broad spectrum of academic disciplines and offer access to a substantial volume of scholarly publications. The above four mentioned electronic databases were searched from 1998 (the start of the positive psychology movement) to February 2023. The last search was run on 16 February 2023. By employing a multi-database search approach, the reviewers aimed to comprehensively capture a diverse range of relevant articles pertaining to the research topic. In addition to the electronic database search, the reviewers employed a manual search strategy. They checked the citations and reference lists of the included articles to identify additional studies that may have been missed in the initial database search. They also reviewed relevant review articles to ensure a comprehensive inclusion of relevant studies. The results of the search are presented in Figure 1, which was likely included in the publication or report. Figure 1 may depict a

flowchart illustrating the search process and the number of articles identified at each stage (e.g., initial search results, screening, inclusion/exclusion criteria, final included studies).

2.1 Eligibility Criteria

The PICOS tool, which stands for Participants, Interventions, Comparison, Outcomes, and Study Design (Amir-Behghadami & Janati, 2020), was utilized as the inclusion criteria for selecting relevant articles for this review. The following criteria were applied to ensure the inclusion of appropriate studies:

Participants: Only university or college students were considered eligible for inclusion in this review. This criterion was set to maintain consistency in the sample population and to focus specifically on the experiences of this particular group.

Interventions: Studies that employed savoring interventions or programs were included. Savoring interventions typically involve structured activities designed to enhance individuals' ability to savor positive experiences. These interventions aim to increase the individual's awareness, attention, and appreciation of PEs and experiences.

Comparison: Studies with control groups that received no intervention or alternative interventions were included. By including control groups, the researchers can compare the outcomes of the savoring interventions to those of other conditions and assess the specific effects of savoring interventions on PEs.

Outcomes: The studies needed to assess PEs using reliable measurement instruments before and after the intervention. Measuring PEs allow researchers to determine the impact of savoring interventions on the emotional well-being of university or college students.

Study design: Studies that met rigorous methodological criteria, including randomized controlled trials (RCTs), cluster randomized controlled trials, or matched-pair designs with randomization, were included in this review. These robust research designs were selected to mitigate the potential for bias and enhance the validity of the study findings. By incorporating studies with such rigorous designs, the review aimed to ensure the reliability and credibility of the research findings.

To ensure the focus of the review and maintain methodological rigor, the following studies were excluded:

Studies that did not utilize rigorous experimental designs or qualitative methodologies were excluded from this review. By excluding studies with less robust methodological approaches, the review aimed to ensure the reliability and validity of the included studies. The focus on rigorous designs helps to minimize confounding factors and enhance the overall quality of the evidence synthesized in this review. This decision aimed to maintain the focus on quantitative data and experimental studies that can provide stronger evidence for the effects of savoring interventions on PEs.

Studies not published in the English language were excluded to maintain consistency in the language of analysis and facilitate accessibility for the reviewers. Studies that combined savoring interventions with other well-being enhancement strategies were excluded. This exclusion was implemented to ensure a clear causal link between the savoring interventions and the observed changes in PEs without the potential confounding effects of additional interventions.

This review specifically concentrated on empirical studies that offered experimental evidence concerning the impact of savoring interventions on positive emotions (PEs) in university students. To maintain focus, case studies, theoretical articles, and surveys were excluded from the analysis.

2.2 Selection of Studies

The systematic searching process within the four mentioned databases utilized Boolean operators and search terms to refine the search and retrieve relevant studies. The adopted search terms and operators were as follows:

Search terms related to the target population: "university students," "college students," and "undergraduate."

Search terms related to the interventions under investigation: "intervention," "treatment," "training," "therapy," and "program."

Search terms related to the outcome of interest: "well-being," "wellbeing," "happiness," "positive emotion," "positive affect," and "PANAS."

These terms were combined using Boolean operators to create a comprehensive search strategy. The operators employed were "AND" and "OR." The "AND" operator was used to narrow down the search results by ensuring that all the specified terms were present in the retrieved studies. The "OR" operator was used to broaden the search by including alternative terms or synonyms.

After conducting the searches, the retrieved studies underwent a series of evaluation steps. The PICOS tool was used to assess if the studies met the pre-established inclusion criteria. PICOS stands for Population, Intervention, Comparison, Outcome, and Study design, and it helps evaluate the relevance of studies based on these criteria.

Initially, the researchers removed duplicate studies to ensure that each study was unique. Then, they proceeded to evaluate the title and abstract of the remaining studies to determine their potential eligibility. Studies that met the pre-established criteria based on their title and abstract were further considered.

Following the title and abstract screening, the researchers conducted a thorough reading of the full text of the remaining studies. This step aimed to carefully evaluate the studies' content and ensure they fulfilled the eligibility criteria established for the meta-analysis.

Ultimately, a total of 14 studies were deemed eligible and met the inclusion criteria for the meta-analysis. These 14 studies constituted the body of research that investigated the effects of savoring interventions on PEs of university students. The selected studies utilized experimental designs, indicating an attempt to establish a causal relationship between savoring interventions and PEs.

The selection process was conducted by two independent reviewers to ensure a rigorous evaluation and maintain consensus. Figure 1 visually depicts the specific selection procedure, likely showing the flowchart or diagram illustrating the steps taken during the study selection process.

2.3 Data Extraction

In the meta-analysis, data collected from the eligible studies encompassed information such as authors, year of publication, study location, sample size, study design, intervention nature, and the type of savoring intervention (past-, present-, future-focused). Additionally, data included details regarding the dosage and duration of the intervention, as well as outcome measures and variables employed to assess the impact on PEs. This comprehensive dataset allowed for a thorough examination of the effects of savoring interventions on university students' PEs, facilitating a comprehensive analysis of the research findings.

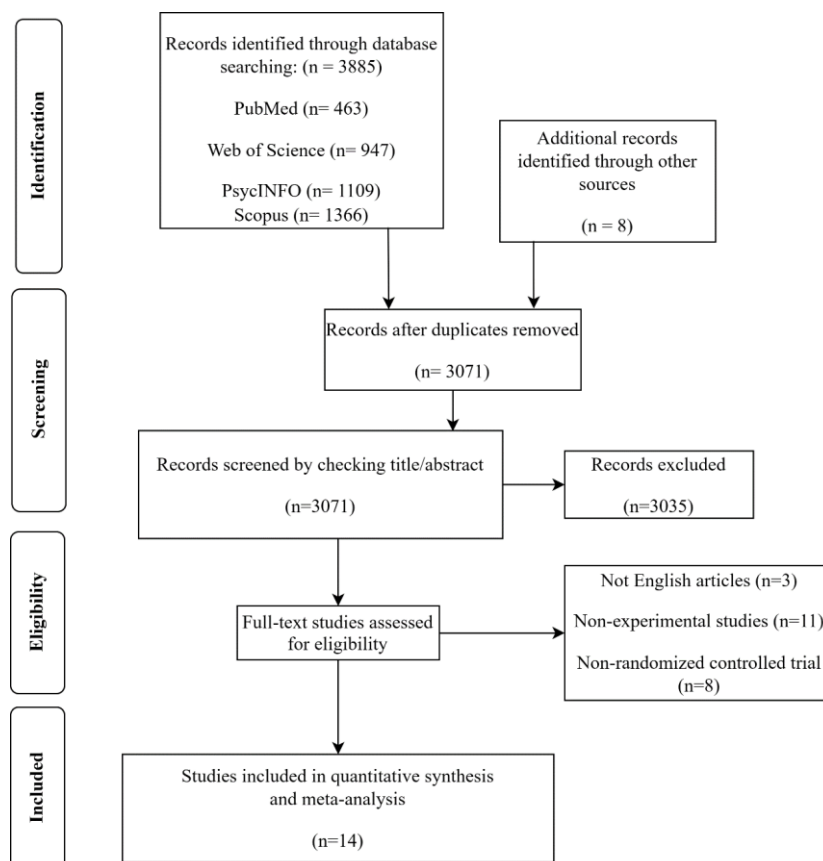


Figure 1. The flow diagram of the search process

2.4 Quality Assessment and Publication Bias

The methodological quality of the studies included in the research was evaluated using the "QualSyst"

quantitative studies assessment tool (Kmet et al., 2004). This tool comprises 14 items that were scored based on the degree to which specific criteria were met, with scores ranging from 0 to 2 (0 for "no," 1 for "partial," and 2 for "yes"). By considering the relevant items, the summary score for each paper was calculated. To ensure reliability, two independent reviewers conducted the evaluation process.

To assess publication bias within the study, three methods were employed: funnel plots, Egger's test, and Begg's test. Funnel plots were used to visually display the distribution of effect sizes (ESs) and determine if the meta-analysis encompassed all pertinent interventions without publication bias. A symmetrical distribution of ESs around the mean in the funnel plot suggests the absence of publication bias, while an asymmetrical distribution indicates its presence (Cuijpers, 2016). Furthermore, the detection of funnel plot asymmetry was further examined using Egger's test (Begg & Mazumdar, 1994) and Begg's test (Egger et al., 1997), which provide statistical measures to evaluate the presence or absence of publication bias based on the observed asymmetry in the funnel plot.

2.5 Statistical Analysis

In order to calculate the ES in each study, we utilized the means, standard deviations (SD), and sample sizes. When mean and SD data were not available, we derived the ESs using a 95% confidence interval (CI), standard error of the mean, and other relevant statistics such as *t* and *F* values. For comparisons between savoring interventions and control groups, we calculated Hedges' *g*, as it provides greater accuracy for small samples compared to Cohen's *d* (Cuijpers, 2016). The meta-analysis adopted a random-effects model following the approach outlined by Borenstein et al. (2010). To evaluate the magnitudes of the ESs, we employed the criteria established by Lipsey and Wilson (2001a), which categorized them as small (0-0.32), medium (0.33-0.55), or large (0.56-1.2). We assessed the heterogeneity of the ESs using the I^2 statistic, where values of 25%, 50%, and 75% represented low, moderate, and high heterogeneity, respectively (Higgins & Thompson, 2002). To investigate potential publication bias, we employed a funnel plot and conducted Egger's (1997) test. The significance level for statistical tests was defined as $p < .05$. All data analyses were performed using Comprehensive Meta-Analysis software 3.7 (Biostat, NJ, USA).

3. Results

3.1 Study Inclusion

Our comprehensive search extracted 3,885 records from diverse databases, including PubMed, Web of Science, PsycINFO, and Scopus. With added discoveries from reference lists and third-party sources, the pool expanded by 8 records. After skillfully removing duplicates, 3,071 records faced the initial screening, and also, 3,035 were left behind as they failed to meet the inclusion criteria during the tantalizing evaluation of abstracts and titles. Digging deeper, 36 full-text articles were scrutinized, leading to the exclusion of 22 studies that lacked experimental designs or penned in foreign tongues. Finally, like gems glistening in Figure 1, 14 randomized controlled trials were chosen to sparkle within the meta-analysis.

3.2 Overview of Studies

The characteristics of the included studies are presented in Table 1. All studies encompassed in this analysis were published between July 2001 and February 2023. The majority of studies (11 out of the total) were conducted in Western countries. Furthermore, all studies were randomized controlled trials, involving a combined total of 1,178 subjects. Sample sizes ranged from 27 to 145 participants. The duration of the interventions varied, spanning from 15 minutes to 3 weeks. Specifically, four studies employed present-focused savoring intervention strategies such as taking meaningful photos, sharing positive experiences, and engaging with nature (Klibert et al., 2022; Passmore et al., 2022; Yu et al., 2020; Zhang et al., 2023). Additionally, seven studies utilized past-focused savoring intervention techniques, including recalling positive memories or experiences and performing acts of kindness (Bryant et al., 2005; Contractor et al., 2020; Datu et al., 2022; Frein & Ponsler, 2014; Lyubomirsky et al., 2006; McMakin et al., 2011; Ouweneel et al., 2014). Lastly, four studies adopted future-focused savoring intervention strategies, such as envisioning one's best possible self (Frein & Ponsler, 2014; King, 2001; Nicolson et al., 2020; Sheldon & Lyubomirsky, 2006). All of the included studies assessed PEs, with the primary measure being the Positive and Negative Affect Scale (PANAS) (Watson et al., 1988).

3.3 Quality Assessment and Publication Bias

The methodological quality assessment of the included studies is presented in Table 2, utilizing the QualSyst tool. Two independent reviewers provided ratings ranging from 0.75 to 0.93, with the first researcher obtaining a mean rating of 0.77 and the second researcher achieving a mean rating of 0.78 (on a scale of 0-1). Consequently, all studies included in this meta-analysis exhibited a relatively high level of quality. The funnel plot of the 14 ES

is displayed in Figure 2, appearing potentially symmetrical. Both Begg's test for small-study effects and Egger's regression test indicated the absence of publication bias, with p-values of 0.208 and 0.384, respectively.

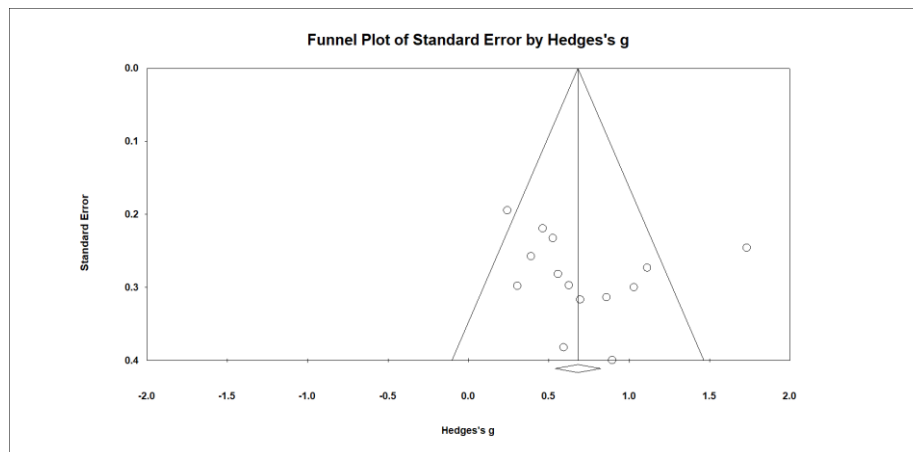


Figure 2. Funnel plot of the overall mean ES analysis

3.4 Post-intervention Effect of Savoring Interventions

The primary focus of this meta-analysis was to evaluate the impact of savoring interventions on PEs by analyzing the observed increase in PEs after implementing these interventions. To ensure a comprehensive analysis and explore potential variations in effectiveness, the meta-analysis was structured based on three distinct time dimensions of savoring interventions: past-focused, present-focused, and future-focused interventions. This categorization facilitated a detailed examination of whether present-focused savoring interventions yielded stronger effects compared to past- and future-focused interventions. Given the heterogeneity in samples, measures, and study designs across the included studies, random-effect models were employed for the analyses. A significance level of $p < 0.05$ was utilized to determine the presence of meaningful effects.

Table 1. Overview of Included Studies

No	Author(s)	Participants	N	Country	Design	Nature of intervention	Time dimensions	Dosage & Duration	Outcome measure	Outcome variables
1	Passmore & Howell (2014)	Undergraduate students	84	Canada	2-group pretest-posttest	Daily nature involvement	Present-focused	Do as much as you can for 2 weeks	PANAS-PA	Positive emotion
2	Zhang et al. (2023)	College students	90	China	2-group pretest-posttest	Taking meaningful photographs	Present-focused	every 2 days for 2 weeks	PANAS-PA	Positive emotion
3	Yu et al. (2020)	University students	122	Taiwan	2-group pretest-posttest	Sharing positive events via Facebook	Present-focused	20 min a day at least three times a week for 3 weeks	PANAS-PA	Positive emotion
4	Klibert et al. (2022)	Undergraduate students	145	USA	5-group pretest-posttest	Mindfully reading the strengths-based passage	Present-focused	15 min in the lab	PANAS-PA	Positive emotion
5	Lyubomirsky et al. (2006)	Undergraduate students	111	USA	4-group pretest-posttest	Thinking about positive events	Past-focused	15 min each day for 3 days	PANAS-PA	Positive emotion
6	Contractor et al. (2020)	Undergraduate students	65	USA	3-group pretest-posttest	Writing specific positive memory	Past-focused	Twice over 2 weeks	PANAS-PA	Positive emotion

7	Ouweneel et al. (2014)	Undergraduate students	49	Netherlands	3-group pretest-posttest	Doing acts of kindness	Past-focused	Five acts of kindness each day for 1 week	JAWS (Job-related Affective Well-being Scale)	Positive emotion
8	McMakin et al. (2011)	Undergraduate students	27	USA	2-group pretest-posttest	Writing positive experience	Past-focused	20 min three separate writing sessions within 2 weeks	PANAS-PA	Positive emotion
9	Bryant et al. (2005)	Undergraduate students	65	USA	3-group pretest-posttest	Thinking about a positive memory	Past-focused	10 min twice a day for 1 week	Fordyce Happiness Measure	Percentage of happy feelings
10	Datu et al. (2022)	Undergraduate students	107	Philippines	3-group pretest-posttest	Doing acts of kindness	Past-focused	10 min each week for 3 weeks	PANAS-PA	Positive emotion
11	Frein & Ponsler (2014)	Undergraduate students	60	USA	4-group pretest-posttest	Writing three good things	Past-focused	15 min each day for 4 days	PANAS-PA	Positive emotion
		Undergraduate students	39	USA	3-group pretest-posttest	Imaging best possible self-activity	Future-based	15 min each day for 4 days	PANAS-PA	Positive emotion
12	Sheldon & Lyubomirsky (2006)	Undergraduate students	67	USA	3-group pretest-posttest	Imaging best possible self-activity	Future-based	at least twice over 2 weeks	PANAS-PA	Positive emotion
13	King (2001)	Undergraduate students	81	USA	4-group pretest-posttest	Imaging best possible self-activity	Future-based	20 min each day for 4 consecutive days	Positive and negative affect scale	Positive emotion
14	Nicolson et al. (2020)	Undergraduate students	66	Netherlands	2-group pretest-posttest	Imaging best possible self-activity	Future-based	5 min each day for 2 weeks	PANAS-X	Positive emotion

Table 2. Quality assessment using QualSyst

No.	Author(s)	Question/objective described	Appropriate study design	Appropriate subject selection	Characteristic sufficiently described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures are well-defined and robust to bias	Appropriate sample size	Analytic methods well-described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Is the conclusion supported by the results?	Total score	Rating	Level
1	Passmore & Howell (2014)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
2	Zhang et al. (2023)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
3	Yu et al. (2020)	2	2	2	2	2	0	0	2	2	2	2	2	2	2	24	0.86	high
4	Klibert et al. (2022)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
5	Lyubomirsky et al. (2006)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
6	Contractor et al. (2020)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
7	Ouweneel et al. (2014)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
8	McMakin et al. (2011)	2	2	2	2	2	0	0	2	1	2	0	2	2	2	21	0.75	high
9	Bryant et al. (2005)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
10	Datu et al. (2022)	2	2	2	2	2	2	2	2	2	2	0	2	2	2	26	0.93	high
11	Frein & Ponsler (2014)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
12	Sheldon & Lyubomirsky (2006)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
13	King (2001)	2	2	2	2	1	0	0	2	2	2	0	2	2	2	21	0.75	high
14	Nicolson et al. (2020)	2	2	2	2	1	0	0	2	1	2	1	2	2	2	21	0.75	high

3.4.1 The Post-intervention Effect of Diverse Savoring Interventions on PEs

A total of 14 studies were included in this meta-analysis to examine the overall ES of various savoring interventions on PEs among university students. Each study compared a savoring intervention group with a control group and reported the difference in PEs between the two groups post-intervention. The ES was calculated as Hedge's g , a standardized mean difference. The combined analysis of the 14 ESs yielded an overall ES estimate of 0.706, with a standard error of 0.117, indicating that, on average, students in the savoring intervention group reported 0.706 standard deviations (SD) higher PEs compared to those in the control group. The 95% confidence interval (CI) for the mean effect size ranged from 0.477 to 0.935, suggesting that the true mean ES of savoring intervention will fall within this range 95% of the time. The Z-value was 6.042, with a corresponding p-value of 0.000, providing strong evidence that diverse savoring interventions have a statistically significant impact on university students' PEs. The forest plot visually displayed the individual study estimates and their respective confidence intervals at a 95% level. Each study's ES was represented by a square, while horizontal lines indicated their CIs. The Q-value was 32.437 with 13 degrees of freedom, indicating more dispersion than expected by chance. Furthermore, the estimated I^2 value was 59.922%, indicating moderate heterogeneity in the overall effect. The variance of the mean ES was 0.111 (T- statistic), and the standard deviation was 0.334 (T-statistic). The weight assigned to each study ranged from 5.04% to 9.17%.

Table 3. Diverse savoring interventions overall mean ES summary and test for heterogeneity

k	N	Hedges'g	95% CI	Homogeneity test			Tau-squared			Test of null (2-tailed)	
				Q(g)	p	I^2	Tau2	SE	Tau	Z	P
14	829	0.706	[0.477,0.935]	32.437	0.00	59.922	0.11	0.07	0.334	6.042	0.000

K= Number of effect sizes; CI = confidence interval.

Savoring intervention vs. Control | Increasing positive emotions

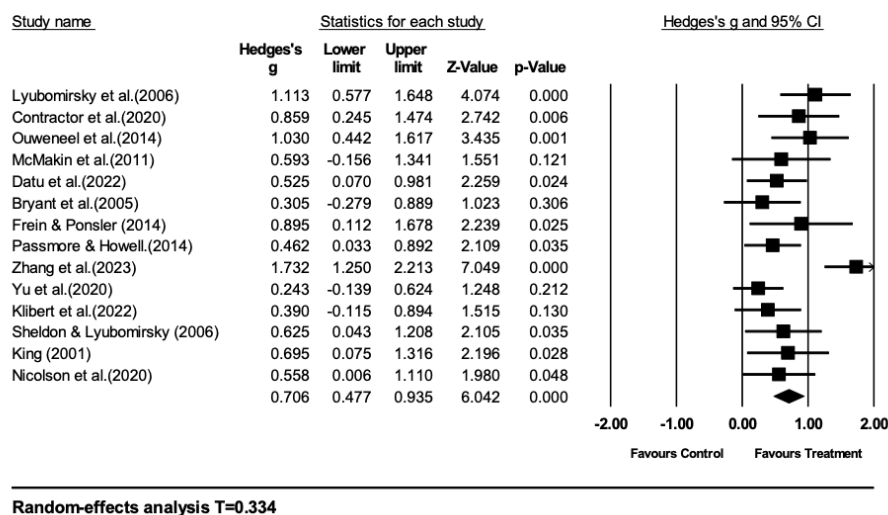


Figure 3. Forest plot of post-intervention effect sizes of diverse savoring interventions on PEs

Table 4. Subgroup comparison results of categorical variables

Moderator	k	g	Point estimate	95%CI	Q	p	I^2
Culture							
Q=32.437** (p=0.001)							
Western	10		0.646	[0.469,0.822]	8.174	0.517	0.000
Nonwestern	4		0.744	[0.506,0.982]	23.837	0.000	87.415

Note. K= Number of effect sizes; CI = confidence interval.

To examine potential factors that may influence the effects of savoring interventions on PEs, the researchers conducted subgroup analyses to test for moderators. These moderators included categorical variables such as culture and intervention types, specifically based on three different time focuses: past, present, and future (see Table 4).

When considering culture as a moderator, the results indicated that the effect size (ES) for the relationship between savoring intervention and both Western and non-Western cultures was statistically significant ($p < 0.001$). However, no significant differences were found between Western and non-Western cultures ($Q = 0.425$, $p = 0.514$).

When examining intervention types (past-focused, present-focused, and future-focused) as moderators, subgroup analysis revealed that there was no significant difference among these intervention types ($Q = 0.359$, $p = 0.836$). Nevertheless, the ESs for the three time dimensions of savoring interventions (past, present, and future) were all found to be statistically significant. Further details regarding these findings are provided below:

3.4.2 The Post-Intervention Effect of Past-Focused Savoring Interventions on PEs

A total of seven studies were included in the analysis, providing data on the impact of past-focused savoring interventions on PEs among university students. The results revealed a significant positive effect of past-focused savoring interventions on college students' PEs ([ES] = 0.748; 95% [CI] = 0.520 to 0.975; $p < 0.001$). Furthermore, there was no significant heterogeneity observed for the overall effect, as indicated by a low tau-squared value ($\tau^2 = 0.003$), a non-significant Q statistic ($Q = 6.222$, $p = 0.399$), and a low I-squared value ($I^2 = 3.567\%$). The weight assigned to each study ranged from 8.24% to 23.36%.

Table 5. Past-focused savoring intervention means ES summary and test for heterogeneity

k	N	Hedges'g	95% CI	Homogeneity test			Tau-squared			Test of null (2-tailed)	
				Q(g)	p	I^2	Tau ²	SE	Tau	Z	P
7	326	0.748	[0.520, 0.975]	6.222	0.399	3.567	0.003	0.055	0.058	6.451	0.000

Note. K= Number of effect sizes; CI = Confidence interval.

Past-focused savoring intervention vs. Control | Increasing positive emotions

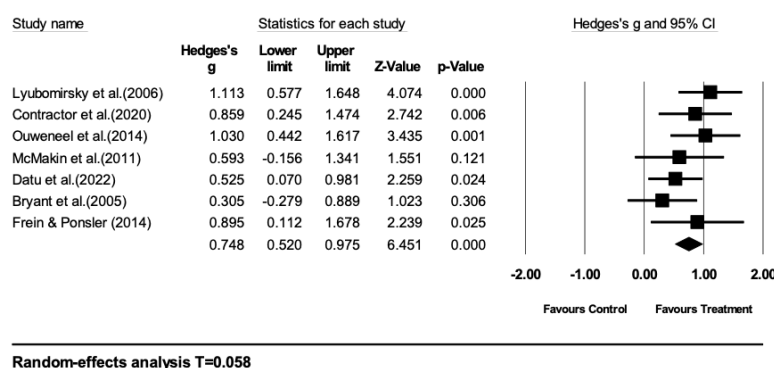


Figure 4. Forest plot of post-intervention effect sizes of past-focused savoring interventions on PEs

3.4.3 The Post-intervention Effect of the Present-focused Savoring Intervention on PEs

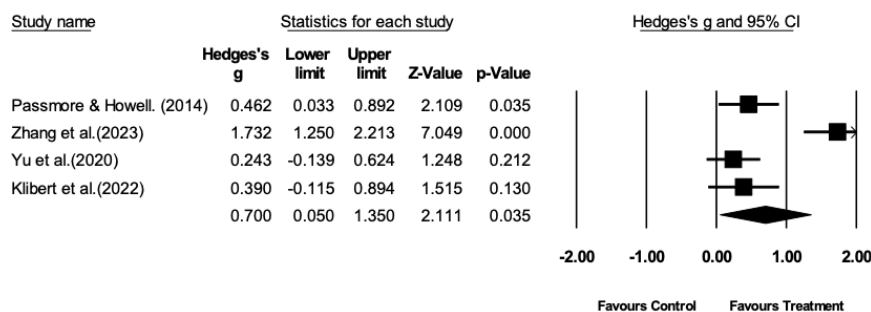
Four studies were included in the analysis, providing data on the impact of present-focused savoring interventions on PEs among university students. The results revealed a significant positive effect of present-focused savoring interventions on college students' PEs ([ES] = 0.700; 95% [CI] = 0.050 to 1.350; $p = 0.05$). However, it is important to note that there was high heterogeneity observed for the overall effect, as indicated by a substantial tau-squared value ($\tau^2 = 0.387$), a significant Q statistic ($Q = 25.527$, $p < 0.001$), and a large I-squared value ($I^2 = 88.248\%$). The weight assigned to each study ranged from 24.26% to 25.88%.

Table 6. Present-focused savoring intervention means ES summary and test for heterogeneity

Homogeneity test							Tau-squared			Test of null (2-tailed)	
k	N	Hedges'g	95% CI	Q(g)	p	I ²	Tau ²	SE	Tau	Z	P
4	339	0.700	[0.050,1.350]	25.527	0.000	88.248	0.387	0.362	0.622	2.111	0.035

Note. K= Number of effect sizes; CI = Confidence interval.

Present-focused savoring intervention vs. Control | Increasing positive emotions



Random-effects analysis T=0.622

Figure 5. Forest plot of post-intervention effect sizes of present-focused savoring interventions on PEs

3.4.4 The Post-intervention Effect of Future-focused Savoring Interventions on PEs

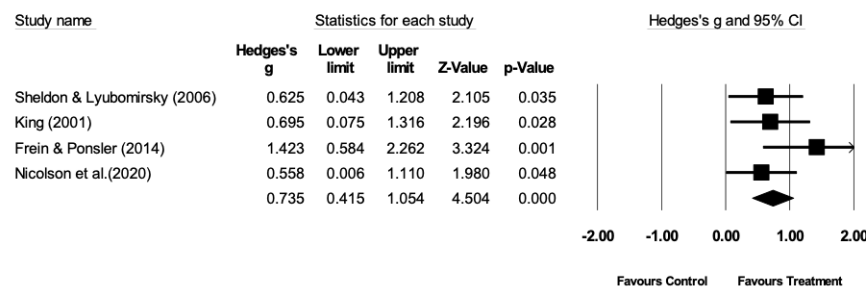
Data from four studies were analyzed to examine the impact of future-focused savoring interventions on PEs. The findings revealed a statistically significant effect of future-focused savoring interventions on PEs ([ES] = 0.735; 95% [CI] = 0.415 to 1.054; $p < 0.001$). Furthermore, there was no significant heterogeneity observed for the overall effect, as indicated by a small tau-squared value ($\tau^2 = 0.004$), a non-significant Q statistic ($Q = 3.129$, $p = 0.372$), and a low I-squared value ($I^2 = 4.131\%$). The weight assigned to each study ranged from 14.17% to 31.73%.

Table 7. Future-focused savoring intervention means ES summary and test for heterogeneity

Homogeneity test							Tau-squared			Test of null (2-tailed)	
k	N	Hedges'g	95% CI	Q(g)	p	I ²	Tau ²	SE	Tau	Z	P
4	164	0.735	[0.415, 1.054]	3.129	0.372	4.131	0.004	0.089	0.067	4.504	0.000

Note. K= Number of effect sizes; CI = Confidence interval

Future-focused savoring intervention vs. Control | Increasing positive emotions



Random-effects analysis T=0.067

Figure 6. Forest plot of post-intervention effect sizes of future-focused savoring interventions on PEs

4. Discussion and Implications

Savoring interventions have emerged as effective positive psychological strategies to enhance individuals' positive experiences, and they have gained popularity across diverse populations. While previous empirical research has provided evidence supporting the effectiveness of savoring interventions in enhancing PEs (F. B. Bryant, 2021; Smith & Bryant, 2017), there is a limited understanding of their impact specifically among college students. Additionally, it remains unclear whether present-focused savoring interventions yield stronger effects on PEs compared to past and future-based interventions. To address these gaps, the present study conducted a meta-analysis to investigate the effects of savoring interventions on PEs in university students through randomized controlled trials. Furthermore, we hypothesized that present-focused savoring interventions would have a greater impact on generating PEs compared to past and future-based interventions. The results of our meta-analysis demonstrated the efficacy of various savoring interventions in improving university students' PEs. As a result, we encourage educational policymakers and practitioners to incorporate savoring interventions in higher education settings as effective self-help tools aimed at promoting students' mental well-being.

4.1 Effect of Diverse Savoring-based Interventions on PEs

The meta-analysis, which included 14 ESs from 14 empirical studies examining the effect of savoring interventions on PEs among university students, yielded an overall effect size of 0.706 ($p < 0.001$). The 95% confidence interval for the overall effect size ranged from 0.477 to 0.935. These findings indicate that diverse savoring interventions effectively enhance PEs in university students, with the effect size classified as large according to standard cutoff values (Lipsey & Wilson, 2001b). These results align with research conducted on the general population (Smith et al., 2014), suggesting that savoring interventions are highly beneficial in improving PEs among university students. This finding is particularly promising for higher education professionals who aim to cultivate students' well-being and positive experiences, enabling them to navigate mental health challenges and successfully complete their studies.

According to Fredrickson (2001), PEs contribute to individuals' broadened attention and expanded thought-action repertoires (Fredrickson & Branigan, 2005), subsequently reducing negative emotions (Estrada et al., 1994, 1997; Isen et al., 1987). Moreover, PEs foster the development of enduring personal resources, enabling individuals to better cope with negative emotions and perform at a higher level. Therefore, PEs initiate upward spirals of emotional well-being. Thus, the current study provides support for the effectiveness of savoring interventions as a strategy to improve PEs among university students.

4.2 Effect of Savoring Interventions in Different Time Frames on PEs

Savoring interventions can be classified into three different time dimensions: past-focused, which directs attention to past positive experiences; present-focused, which involves manipulating attention towards present positive experiences; and future-based, which directs attention to anticipated future experiences. Previous studies have suggested that present-focused savoring interventions, such as mindful photography, are more effective than past-based interventions like recalling three good things or future-based interventions like using the best possible self, in eliciting short-term increases in PEs.

However, the current meta-analysis reveals that past-focused savoring interventions are more effective in promoting PEs compared to both past and future-based interventions. Specifically, the meta-analysis of seven ESs from past-focused savoring intervention studies resulted in an overall effect size of 0.748 ($p < 0.001$), with a 95% confidence interval of 0.520 to 0.975. These findings indicate that past-based savoring interventions positively impact and increase university students' PEs. According to standard cutoff values, the effect size regarding past-based savoring interventions is classified as large (Lipsey & Wilson, 2001b).

Moreover, four empirical studies demonstrated the effectiveness of present-based savoring interventions in increasing university students' PEs ($ES = 0.700$; 95% $CI = 0.050$ to 1.350 ; $p = 0.05$), with the effect size classified as large (Lipsey & Wilson, 2001b). Similarly, four empirical studies indicated that future-based savoring interventions also positively influenced university students' PEs, resulting in an overall effect size of 0.735 ($p < 0.001$) and a 95% confidence interval of 0.415 to 1.054, classified as large (Lipsey & Wilson, 2001b). Overall, savoring interventions across different time dimensions (past, present, and future) significantly and differentially impact PEs among university students. However, among the three categories, past-focused savoring interventions demonstrated the strongest effect ($ES = 0.748$) in increasing university students' PEs, followed by present-focused interventions ($ES = 0.700$) and future-focused interventions ($ES = 0.735$). Therefore, savoring through reminiscence appears relatively superior in terms of increasing PEs. This finding contradicts previous studies (Bryant, 2003). One possible explanation for these differential effects is that individuals often recall and imagine the past and future from a "rosy" perspective (Mitchell et al., 1997). In other words, when reminiscing

about the past or envisioning the future, individuals tend to recall more positive experiences rather than negative ones. This selective recall and imagination of positive events contribute to a better appreciation of past positive experiences and positive anticipation of future events, ultimately enhancing their present experience of positivity.

However, due to the presence of a negativity bias (Baumeister et al., 2001), individuals need to allocate cognitive resources to counteract this bias when savoring the present, potentially reducing the intensity of their positive emotional experiences. Additionally, compared to savoring the past and future, present-focused savoring interventions require participants to actively notice positive aspects of their immediate environment, amplifying and prolonging their positive experiences in the present moment. However, present-focused interventions may be more susceptible to distractions, making individuals more vulnerable to interference and potentially reducing the intervention's effectiveness. Overall, our meta-analysis provides evidence that past-focused savoring interventions are more effective in improving PEs among university students compared to present- and future-focused interventions.

5. Study Limitations and Recommendations for Future Studies

This review has some limitations. Firstly, the included papers in this current study are peer-reviewed English publications. Although data analysis has indicated a low likelihood of publication bias, it may influence the final analysis results. Secondly, while the savoring interventions included in this study were conducted in different countries, most of them were carried out in English-speaking countries. Therefore, the generalizability of the findings to non-English-speaking countries remains uncertain. Thirdly, the included papers in this meta-analysis had relatively small sample sizes, despite employing randomized controlled pre-post experimental designs. Subsequent studies could employ larger samples to further validate the effects of savoring interventions. Fourthly, future research could utilize longitudinal designs to examine the long-term maintenance effects of savoring interventions. This would allow students and educators to choose more effective savoring intervention techniques based on the sustainability of their effects, thereby promoting long-lasting PEs and emotional well-being. Fifth, since this study primarily focused on PEs as the outcome variable, other outcome variables such as life satisfaction, psychological well-being, and resilience were not included. Hence, future research can further investigate the effects of savoring interventions on these outcome variables to provide a more comprehensive evaluation of the effectiveness of savoring interventions. Lastly, due to the limited number of included papers in this meta-analysis, some potential moderating variables such as gender and dropout rate were not analyzed. Therefore, future studies could consider incorporating these moderator variables for further investigation.

6. Conclusion

This meta-analysis aimed to address the gap in the systematic assessment of savoring interventions in higher education settings by synthesizing the efficacy of these interventions on PEs among university students. The results of this meta-analysis demonstrated that diverse savoring interventions can effectively increase university students' PEs. Specifically, past-focused savoring interventions were found to be more powerful in enhancing PEs compared to present and future-focused interventions. These findings highlight the potential of savoring interventions as a means to optimize college students' mental health and emotional well-being. The implications of this study are significant for education policymakers and practitioners. Incorporating savoring interventions into classroom teaching and extracurricular activities, particularly focusing on past-focused strategies, can contribute to enhancing the emotional well-being of college students. By providing students with effective tools to savor positive experiences from the past, educational environments can foster a positive and supportive atmosphere that promotes students' mental health and overall well-being.

However, it is important to acknowledge certain limitations of this meta-analysis. The assessment of savoring interventions in higher education settings was not previously systematically conducted, and the current study addressed this gap to some extent. Nonetheless, future research should continue to explore the effectiveness of savoring interventions in diverse educational contexts and consider other outcome variables related to well-being and resilience. Additionally, the generalizability of the findings may be limited by the predominance of studies conducted in English-speaking countries. Therefore, conducting studies in non-English-speaking countries would contribute to a more comprehensive understanding of the effects of savoring interventions on PEs among university students. In conclusion, this meta-analysis underscores the effectiveness of diverse savoring interventions in increasing PEs among university students. The findings support the integration of savoring interventions into higher education settings to promote students' emotional well-being. By implementing past-focused savoring strategies, educators and policymakers can create an environment that cultivates PEs and fosters students' mental health. Further research should continue to explore and refine the application of savoring

interventions in educational contexts, taking into account cultural and contextual factors to maximize their effectiveness in enhancing college students' emotional well-being.

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Authors contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Obtained.

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Data sharing statement

No additional data are available.

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