Investigating the effects of implicit self-compassion cognitive bias modification on psychological flexibility and the moderating effects of distress among university students

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Abstract

University students face significant mental health challenges, emphasising the necessity of investigating strategies fostering psychological flexibility and self-compassion for adaptive coping. Self-compassion has been largely studied as an explicit concept, while its implicitness remains underexplored. Considering the influence of implicit processes on cognition and behaviour, this study examines implicit and explicit self-compassion, the effects of cognitive bias modification (CBM) on psychological flexibility, and the moderating effects of psychological distress, as well as the mediating effects of implicit self-compassion in this relationship. Using convenience sampling, 42 students aged 18 to 27 were recruited and allocated into experimental (n = 28) and control (n = 14) groups. This experimental and longitudinal study collected data via SoSci Survey, with analyses conducted in RStudio (version 2024.12.1-563). Unexpectedly, CBM did not significantly affect implicit self-compassion or psychological flexibility. However, a marginal trend suggested a potential intervention effect of the CBM. Counter to expectation, explicit and implicit self-compassion did not correlate, and the reliability of the implicit self-compassion measurement was poor. The reliability of the self-report scales was good to excellent. Unexpectedly, implicit self-compassion did not mediate cognitive bias modification on psychological flexibility, and psychological distress showed a marginal trend towards moderating that relationship. Though most results were insignificant, a tendency towards a significant intervention effect and a moderating effect of psychological distress was discovered. The lack of correlation between implicit and explicit self-compassion suggests a need for a robust measurement that can capture the metacognitive complexity of self-compassion.

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Importance of psychological flexibility and self-compassion in university students

Studying at a university or other higher education institution is both an exciting and an emotionally demanding period for many students. It is a time of navigating academic pressure, expectations, unfamiliar environments, questions about identity, life direction and values (Mursalzade et al., 2025). Navigating these life domains and balancing them may result in internal and external pressures which can lead to psychological discomfort, such as nervousness, worry or sadness, as well as manifest mental health issues, such as depression and anxiety (Mursalzade et al., 2025). Particularly the rise in mental health issues in students raises concerns that demand the identification of accessible, low-cost and large-scale interventions to support students' mental health since diminished mental health can hinder academic performance (Kämper et al., 2025) and complicate the adjustment to current academic expectations as well as future ever-changing and uncertain professional environments (Mursalzade et al., 2025).

Two concepts support mental health, namely self-compassion and psychological flexibility (Kämper et al., 2025; Mursalzade et al., 2025; Neff, 2022). According to Ong and Eustis (2023), psychological flexibility is the ability to accept and observe inner experiences without judgement in the present moment and choose to act in accordance with personal values to not only meet one's own needs but also effectively adapt to life‘s variability and difficulties (Arslan, 2024; Arslan et al., 2025; Kämper et al., 2025; Marshall & Brockman, 2016; Moreno, 2023). Psychological flexibility is based on Acceptance and Commitment Therapy (ACT) and consists of six processes (Marshall & Brockman, 2016; Moreno, 2023; Mursalzade et al., 2025; Ong & Eustis, 2023). First, psychological flexibility requires the

willingness to experience the inner world (Acceptance) without avoidance. This also includes observing the various sensations connected to certain emotional states, such as anxiety, like tightness or muscle tensions, without becoming entangled in them (Defusion). The third process encompasses the flexible attention to the present, in which other sensations occurring are attended to next to the internal ones. Fourth, seeing oneself as a context in which all of the above unfolds without seeing oneself as the content of those experiences. Fifth, a clarity around personal values is needed to guide meaningful action. Finally, individuals commit to value-based behaviour, even when they face psychological discomfort (Arslan, 2024; Mursalzade et al., 2025; Ong and Eustis, 2023). These processes allow for improved recovery from distress and life's challenges (Arslan et al., 2025; Kämper et al., 2025; Marshall & Brockman, 2016) as well as promote wellbeing and a meaningful life (Arslan, 2024; Mursalzade et al., 2025). Thus, psychological flexibility acts as a buffer against mental health issues by enhancing effective overcoming of life challenges (Arslan, 2024), such as academic pressure and personal problems. Given psychological flexibility's strong connections to wellbeing and adaptability, psychological flexibility will be considered the main outcome variable within the current study.

A closely connected construct that supports mental health is self-compassion (Arslan, 2024; Neff, 2022; Marshall & Brockman, 2016; Moreno, 2023). The ability to be kind to oneself, see oneself, including one's struggles as part of humanity, as well as be mindful, is defined by self-compassion (Arslan, 2024; Kämper et al., 2025; Marshall & Brockman, 2016; Moreno,2023; Neff, 2003). Self-compassion is a productive way of approaching distressing thoughts and emotions since it focuses on speaking to oneself kindly, realising the humanness behind suffering and being mindful of one's thoughts and feelings to act in a nurturing manner (Arslan, 2024; De Paul Savarimuthu et al., 2024; Marshall & Brockman, 2016; Moreno, 2023; Neff, 2022). Beyond its nurturing function, self-compassion also serves as a

motivating role by promoting constructive engagement with uncomfortable situations without any shame (Moreno, 2023). It is a form of self-protection motivated by a desire to alleviate suffering and improve well-being through learning from mistakes and responding in an understanding and caring manner (Arslan, 2024; Neff, 2022).

Individuals high in self-compassion tend to act in health-promoting manners such as dieting, exercising and receiving medical care, more often compared to individuals with low self-compassion (Neff, 2022). Therefore, elevated levels of self-compassion are associated with fewer mental health issues (Arslan, 2024; Marshall & Brockman, 2016; Moreno, 2023; Neff, 2022). For instance, in a study by Lee et al. (2021, as cited in Arslan, 2024), increased self-compassion led to decreased distress, loneliness and enhanced mental health over a five-year period. Overall, self-compassion promotes resilience when facing difficult life events and supports healing from trauma (Neff, 2022).

Notably, self-compassion not only improves mental health but may also support the development of psychological flexibility. Since self-compassion is positively associated with adaptive coping (Neff, 2022; Moreno, 2023), it could potentially serve as a nourishing ground for cultivating psychological flexibility. Its association with learning and viewing failures as opportunities (Neff, 2022) may suggest that self-compassion is not only complementary to psychological flexibility, but it could foster it. Additionally, both constructs encourage an open and accepting stance towards inner experiences (Arslan, 2024; Kämper et al., 2025; Marshall & Brockman, 2016; Moreno, 2023), which may be important for students facing several emotional demands. Thus, self-compassion may be a mechanism that cultivates adaptability in the face of stressors by fostering psychological flexibility. However, this potential dynamic has received limited empirical attention since self-compassion and psychological flexibility have been studied as separate contributors to well-being (Moreno,

2023). Therefore, the current study aims to address this gap by exploring whether self-compassion may foster the development of psychological flexibility.

The possible unconscious nature of Self-compassion

The dual processing model provides a notable framework for understanding how both conscious (explicit) and unconscious (implicit) processes operate in parallel (Greenwald et al., 2021; Hofmann et al., 2005; Koop, 2024; Sowder 2024). Explicit constructs are consciously tangible and require mental deliberation, while implicit constructs function automatically, using minimal cognitive effort and tend to be inaccessible to introspection (Greenwald et al., 1998; Hofmann et al., 2005). For instance, spider-phobic individuals may experience anxiety or disgust automatically when presented with an image of a spider, despite no conscious endorsement, suggesting that individuals' automatic responses reveal their feelings outside of their control (Hofmann et al., 2005).

These two systems are distinct yet interrelated, and they may exert influence on cognitions and behaviours separately or interactively (Greenwald et al., 2021; Hofmann et al., 2005). For instance, the implicit system may associate two stimuli without deliberation and exert a behavioural reaction that retrospectively is incorporated into the explicit system (Hofmann et al., 2005). Such incorporation of implicit reactions into the explicit system can also happen in the present through the process of gaining awareness of implicit reactions to stimuli or situations (Hofmann et al., 2005). An example of this is the observation of an individual's avoidance reactions to a minority person resulting from a prejudiced implicit attitude that is consciously integrated into the explicit system (Hofmann et al., 2005). In contrast, it may be that the individual does not consciously hold a prejudiced attitude towards minority groups but subconsciously exerts reactions of holding such attitudes (Hofmann et al., 2005). Thus, though the implicit and explicit systems can be aligned, discrepancies can also arise between them (Hofmann et al., 2005). In the context of self-compassion, for

example, an individual with high levels of explicit self-compassion may act consciously in a loving manner towards themselves. However, if their implicit self-compassion is low, they might feel uncomfortable or conflicted due to repeated experiences in which they were criticised, which may cause a feeling of an innate unworthiness of self-kindness. In contrast, individuals with high explicit self-compassion may also exert high implicit self-compassion, resulting in automatic self-compassionate cognitions and behaviours during challenging situations (Koop, 2024). Though implicit processes operate subconsciously, they can be changed through repeated pairing of stimuli and conscious reflective deliberation, such as through specific construct targeting training (Hofmann et al., 2005).

Overall, implicit and explicit constructs tend to show a moderate positive correlation (Greenwald et al., 2021; Hofmann et al., 2005; Nosek, 2007; Nosek et al., 2007), suggesting that implicit self-compassion may affect psychological flexibility similarly (Kılıç et al., 2022). Thus, by training implicit self-compassion at a subconscious level, individuals may become increasingly resilient to negative cognitions, allowing them to be more flexible, adaptive and ultimately thrive in life. In alignment with this, self-compassion is malleable and can be easily changed even with short interventions (Woodfin et al., 2021). Therefore, using cognitive bias modification to train implicit self-compassion sounds promising.

Measuring implicit self-compassion using the Implicit Association Test (IAT)

Self-compassion has been widely studied in research, commonly measured using explicit self-report scales, such as the Self-compassion Scale by Neff (2022). These measurements mainly focus on assessing the explicit manifestation of self-compassion rather than the implicit. To understand automatic, non-conscious aspects of self-compassion more fully, growing interest arose within the investigation of implicit self-compassion measures, such as an implicit association test (IAT).

The IAT is a tool used to measure automatic, subconscious (implicit) attitudes by examining the associations' strength between two concepts (Greenwald et al., 1998; Greenwald et al., 2021; Nosek et al., 2007). For instance, it might test how strongly "flower" versus "insects" are associated with the categories of "pleasant" or "unpleasant" (Greenwald et al., 1998). These stimuli are sorted into the categories using two response keys (Greenwald et al., 1998; Greenwald et al., 2021; Nosek et al., 2007). More strongly associated categories, such as flower and pleasant, are usually paired faster compared to less strongly associated categories, for example "insect" and "pleasant" (Greenwald et al., 1998; Greenwald et al., 2021; Nosek et al., 2007). By examining the reaction times and the error frequency, whereby fewer errors indicate higher association, the relative strength of these implicit associations is revealed (Greenwald et al., 1998; Greenwald et al., 2021; Nosek et al., 2007).

In the context of self-compassion, the IAT would assess how quickly concepts related to self and compassion are associated compared to uncompassionate traits with self. A recent attempt by Koop (2024) involved the construction of a single-category IAT aimed at measuring implicit self-compassion, including Neff's key dimensions (self-kindness vs. self-criticism, common humanity vs. isolation and mindfulness vs. overidentification). In Koop's study, a single-category IAT was chosen since using "self" and "other" as categories could have invited ambiguity due to compassion being associated with both self and others (Neff, 2022). However, the findings were not statistically significant, prompting questions about whether self-compassion can be captured at the implicit level or whether it is primarily an explicit construct. This idea is further explored within the current study by extending and adjusting Koop's SC-IAT into three brief two-categorical IATs, of which each IAT measures a dimension of self-compassion by Neff (2003) with its opposite to capture the construct more comprehensively and in alignment with the theory of the construct. Additionally, three brief IATs are utilised instead of a single-categorical IAT or standard IAT, targeting only one

dimension, to reduce participant burden. Due to each brief IAT including two blocks of trials instead of four, as in the standard IAT (Sriram & Greenwald, 2009), multiple self-compassion components can be assessed without overwhelming the participants. Moreover, a two-categorical format was selected over a single-categorical one to explore a neutral contrast category. By including a neutral contrast, such as "furniture" instead of an undefined category, it is assumed that greater clarity is introduced into the measurement through focusing on the individuals' identification with compassionate or critical attributes, allowing for potential heightened accuracy (Greenwald et al., 2019). Nonetheless, it remains uncertain whether a neutral category could achieve this effectively (Greenwald et al., 2019). Therefore, its utility will be further explored in the present study.

Training implicit self-compassion using Cognitive bias modification (CBM)

Cognitive bias modification is a computer-based intervention that targets specific implicit cognitive biases (Williams et al., 2013). Implicit cognitive biases are automatic and unconscious patterns of thinking that influence how individuals perceive and respond to situations (Reihl et al., 2015; Sowder, 2024). Therefore, these biases could contribute to maladaptive responses, such as excessive self-criticism, when self-compassion is low. CBM includes tasks in which various pictures or words with cues are presented that need to be pulled closer or pushed away by the participant by using a keyboard or swiping on a touch screen (Sowder, 2024). The push and pull mechanics symbolically reveal how individuals distance themselves from the negative cues and approach the positive ones (Kakoschke et al., 2017; Sowder, 2024). Through repetitive practice, the automatic responses are shifted towards a more adaptive direction by strengthening positive associations and weakening harmful ones (De Paul Savarimuthu et al., 2024). By targeting these biases at an implicit level, so beyond consciousness, CBM can improve emotional and cognitive functioning (De Paul Savarimuthu et al., 2024; Sowder, 2024; Williams et al., 2013). This is essential to

understand because many psychological issues, such as depression and anxiety, are sustained not only through conscious thoughts and behaviours but also through automatic, reflexive biases that shape how individuals process and interact with the world (De Paul Savarimuthu et al., 2024). Training these biases, such as implicit self-compassion, may help interrupt dysfunctional patterns and may promote more flexibility and health-supporting actions, essentially improving mental health.

Moderating role of psychological distress

Although cognitive bias modification has shown improvements in reducing maladaptive thought patterns, the conditions under which it is most effective remain unclear. It is not investigated whether individual differences, such as psychological distress, may influence CBM's efficacy. Prominent levels of psychological distress are known to impair executive functioning and attentional control (Lukasik et al., 2019), both of which are essential for engaging with and benefiting from CBM tasks (Vrijsen et al., 2024). It may be that, in distressed individuals, cognitive resources may be directed toward managing negative affect or thoughts, which could potentially interfere with the implicit learning processes CBM requires (Lukasik et al., 2019). This may align with several cognitive bias modifications failing to affect depression and weakly improving anxiety in clinical samples (Vrijsen et al., 2024). Although the sample of the present study is non-clinical, psychological distress varies meaningfully within the general population. In the research by Piao et al. (2024), more than half of the population reports elevated psychological distress across twelve years. Therefore, it is possible that distress may moderate the individuals' ability to benefit from the CBM. Thus, investigating psychological distress as a moderator helps clarify for whom and under what circumstances CBM is effective in improving psychological flexibility as a mental health supporting trait. For example, it may be that individuals suffering from high distress

might not experience the improving effects of CBM on psychological flexibility compared to those low in distress.

The present study

Ultimately, university students deal with significant mental health challenges, emphasising the necessity of investigating strategies that promote psychological flexibility and resilience. Additionally, self-compassion may be crucial in fostering psychological flexibility. Despite self-compassion being frequently studied as an explicit concept, its implicit nature remains underexplored. Considering how strongly implicit processes could influence cognitions and behaviours, this study aims to examine both implicit and explicit self-compassion, the relationship between CBM and psychological flexibility, the mediating effect of implicit self-compassion (see **Figure 1**) and baseline psychological distress's potential moderation of the relationship, as visible in **Figure 2**. Moreover, this study aims to extend Koop's (2024) study by improving the measurement of implicit self-compassion using three brief IATs for each dimension of self-compassion.

Based on the rationale, the following hypotheses are proposed:

***Hypothesis 1 (Measurement Reliability)*:** The test-retest reliability of the three brief IATs is at least moderate.

***Hypothesis 2 (Implicit-Explicit Correlation)*:** It is expected that the correlation is moderate and positive (between .41 and .6) for explicit and implicit self-compassion.

***Hypothesis 3 (Training effect)*:** The CBM training will be associated with a significant positive change in ISC from pre- to post-measurement, compared to the control group.

***Hypothesis 4 (Mediation)*:** Implicit self-compassion fully and positively mediates the relationship between CBM and psychological flexibility. When controlling for implicit self-compassion, CBM will have a positive direct effect on psychological flexibility. (See **Figure 1**.)

***Hypothesis 5 (Moderation)*:** Psychological distress reduces the effects of CBM on psychological flexibility. This relationship is visualised in **Figure 2.**

Figure 1

The visualisation of the mediating effect of implicit self-compassion in the relationship between cognitive bias modification (CBM) and psychological flexibility

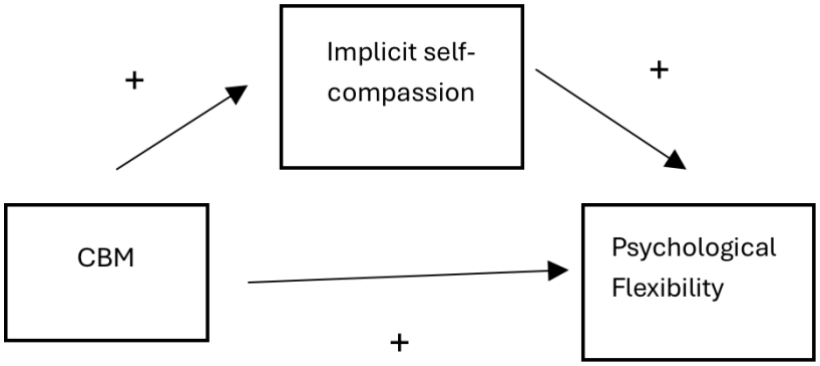
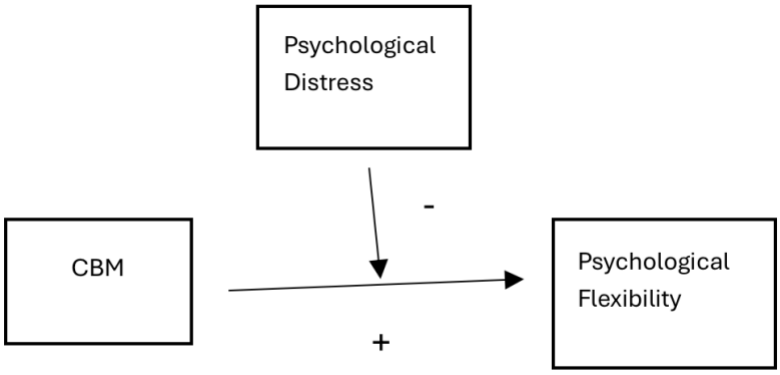


Figure 2

The visualisation of the moderating effect of psychological distress on the relationship between cognitive bias modification (CBM) and psychological flexibility



Methods

Design

The BMS Ethics Committee (request number: 241225) approved the current study before data collection. The design of this study is longitudinal and experimental. At five time

points, data were collected. On the first day, T0, baseline data was collected, consisting of the questionnaires and the IATs. The IATs were constructed within the frame of a research group whereby the questionnaires measured self-focused attention, automatic negative and positive thoughts, psychological distress, psychological flexibility and self-compassion. In the current study, only the scales measuring self-compassion, psychological flexibility and distress were used for the analyses. During the three intervention days for the experimental group, data concerning the CBM were collected. On the fifth day, T1, the post-measures were administered, consisting of the IATs and initial questionnaire, excluding psychological distress, since it was measured at baseline.

Participants

For the recruitment of participants, convenience sampling was used by sharing the on SoSci Survey (Leiner, 2024) constructed survey on social media such as WhatsApp and Instagram, as well as on the SONA system of the Faculty of Behavioural, Management and Social sciences (BMS) Psychology Test subject pool from the University of Twente. On SONA, the study offered the participants one credit. Fifty-eight participants were recruited in total. The inclusion criteria were being proficient in English, above 18, having a stable internet connection and owning or having access to a computer or smartphone. From the total number of participants recruited, only forty-two participants remained in the dataset due to meeting validity of the IATs, by showing a reaction time of less than 10 seconds, answering less than one fourth of the trials wrongly and showing more than three reaction times per block (Greenwald et al., 2003, as cited in *Impliziter Assoziationstest (IAT) [SOSCISurvey]*, n.d.), as well as consenting to the study. Of the overall participants, 14 were allocated to the control group and 28 to the experimental group. In **Table 1**, an overview of the participants' characteristics is displayed.

Table 1

Characteristics of the participants per condition, including age, gender, nationality, educational level and proficiency in English

Demographics	**Experimental group (n = 28)**		**Control group (n = 14)**		**Test Value**
	n	**%**	**n**	**%**	
Age					-0.92[T]
18 - 22	19	68	7	50	
23 - 27	9	32	7	50	
Gender					3.7[c]
Female	21	75	12	86	
Male	7	25	1	7	
Non-binary	0	0	1	7	
Nationality					0.47[c]
German	8	29	3	21	
Dutch	17	61	10	71	
Other, namely	3	10	1	8	
Level of Education					2.4[c]
Secondary school	2	7	0	0	
Vocational Education (NL: MBO, DE: Ausbildung)	2	7	0	0	
University of Applied Sciences (NL: HBO, DE: Fachhochschule)	3	11	2	14	
University (Bachelor's degree)	17	61	9	64	

University (Master's degree)	4	14	3	22	
PhD	0	0	0	0	
Proficiency in English					1.01[c]
Beginner	0	0	0	0	
Intermediate	5	18	4	29	
Advanced	22	79	9	64	
Native	1	3	1	7	

Note. t-test = [T], Chi-Square = [C]

Materials

This study requires access to an electronic device such as a computer or smartphone, the internet, the survey link and the downloaded Twente Intervention and Interaction Machine (TiiM) app. Due to the survey being conducted in the frame of a research group, the total number of items was 118 for the pre-questionnaire and 108 for the post-questionnaire. Only 47 items from the pre-questionnaire and 37 from the post-questionnaire were processed in this study, including demographics, Self-Compassion Scale, Psy-flex Scale and Kessler Psychological Distress Scale. Following each of the questionnaires, the 180 items of the IATs were administered.

Demographics

Information concerning the demographics of the participants was collected by requesting age, gender (“Female”, “Male”, “Non-binary” or “Prefer not to say”), Nationality (“German”, “Dutch” or “Other, namely”), level of education (“Secondary school”, “Vocational Education (NL: MBO, DE: Ausbildung)”, “University of Applied Sciences (NL: HBO, DE: Fachhochschule)”, “University (Bachelor degree)”, “University (Master degree)” or “PhD”) and proficiency in English ranging from “Beginner” over “Intermediate” and “Advanced” to “Native”.

Self-Compassion Scale (SCS)

Explicit self-compassion was assessed using the 26-item Self-Compassion Scale by Neff (2003). This scale covers the six dimensions of self-compassion (Self-kindness, Self-judgement (reversed scores), Common Humanity, Isolation (reversed scores), Mindfulness and Overidentification (reversed scores)). For the total score, first, the negative subscales were reversed. Then, the mean of each subscale was taken, and a total mean was computed. The reliability and test-retest reliability of the scale are good (alpha = .92, alpha = .93) (Neff, 2003). The reliability and the test-retest reliability of the subscales are also good (ranging from alpha = .75 to .81 and .80 to .88) (Neff, 2003).

Psy-Flex Scale

Psychological flexibility was assessed using the 6-item Psy-Flex scale by Gloster et al. (2021) which covers each skill from the ACT therapeutic model (“being present”, “being open for experience”, “leaving thoughts be”, “steady self”, “awareness of one’s own values” and “being engaged”). It is a 5-point scale ranging from 1 (very seldom) to 5 (very often). The total score was calculated by summing the answers. The higher the score, the higher the psychological flexibility (Gloster et al., 2021). The Psy-flex is a one-factor scale with high reliability (alpha = .91) and solid validity (Gloster et al., 2021).

Kessler Psychological Distress Scale (K10)

To measure psychological distress, the 10-item Kessler Psychological Distress Scale (K10) by Kessler et al. (2003) was administered. This 5-point scale ranged from 1 (“none of the time”) to 5 (“all of the time”). The higher the sum-score, the higher the level of psychological distress. Further, according to Kessler et al. (2003), the scale can be used for screening of a likelihood of having a mental disorder using set cut-off scores (“10 -19 Likely to be well”, “20 - 24 Likely to have a mild disorder”, “25 - 29 Likely to have a moderate

disorder" and "30 - 50 Likely to have a severe disorder"). Similarly to the Psy-flex, this scale is unidimensional and shows a high reliability (alpha = .93) (Da Silva et al., 2021).

Implicit Association Test for Self-compassion (IAT-SC)

The three brief IATs were constructed based on Koop's IAT (2024). Each brief IAT covered one of the three dimensions of self-compassion (kindness vs. Judgement, common humanity vs. Isolation and mindfulness vs. Overidentification). The three brief IATs for each dimension of self-compassion consisted of four blocks, namely two congruent blocks with high self-compassion and two incongruent blocks. The congruent categories were "Compassion/Me" and "Criticism/Furniture", while the incongruent categories were "Criticism/Me" and "Compassion/Furniture". The furniture category included items such as "chair", "desk", "table", "couch" and "bed". Compared to Koop's IAT, this study included, adjusted and removed items to holistically encapsulate the constructs and increase clarity. These changes are displayed in **Table 2**. Concerning the interpretation of the D-scores, a positive score indicates a congruent association between the target and the positive concept. For example, pairing of compassion and I-related items with the Compassion/Me category (*About the IAT*, 2019). This indicated the presence of an implicit self-compassion bias. On the contrary, a negative D-score indicates an incongruent association between the target and the negative concept, meaning a pairing of compassion and furniture-related items with the Compassion/Furniture category as well as criticism and I-related items with the Criticism/Me category, suggesting an opposite bias (*About the IAT*, 2019). A score of zero indicates the nonexistence of a bias (*About the IAT*, 2019).

Cognitive bias modification training (CBM)

The CBM was based on the three brief IATs and consisted of 90 items, including the "Furniture" and "Me" items, for each module. It was constructed in the Twente Intervention and Interaction Machine (TiiM) app (*Twente Intervention and Interaction Machine (TIIM)* |

Infohub | BMS Lab, n.d.). The TiiM app was developed by the BMS Lab at the University of Twente and is used for creating interventions and several kinds of studies (*Twente Intervention and Interaction Machine (TIIM) | Infohub | BMS Lab*, n.d.). One of those studies is the IVY CBM training, which aimed to prevent fatigue in breast cancer-affected individuals by pairing vitality items with the I-category and fatigue items with the other category through swiping motions either towards the client or away (Geerts et al., 2024). The same mechanics are utilised in the current study. During the current training, the participants were asked to move the item in the middle shown to either the Compassion/Me category or the Criticism/Furniture category. Implicit self-compassion is trained by repeatedly swiping compassion and I-related items towards the participant, and criticism, as well as furniture-related items away, similar to an approach-avoidance task (Kakoschke et al., 2017). When correctly assigned, the category to which the item was moved turned green. When wrongly assigned, the category to which the item was moved turned red. This is visualised in **Figures 3 - 5**.

Procedure

Data was collected from the 28th of January until the 17th of March 2025. The study link from SosciSurvey (Leiner, 2024) was posted on the SONA system of the Psychology Test subject pool from the BMS of the University of Twente and distributed on social media such as WhatsApp and Instagram. The link connected the participants to a Google form to share their email addresses for the researchers to manually assign the participants to either the experimental or control group. Based on the sign-ups, the experimental group was filled first, then the control group. Both groups started by completing self-report assessments related to self-compassion, rumination, automatic thoughts, self-focused attention, psychological flexibility, and psychological distress and completing the first self-compassion IATs. This took around 30 minutes to complete. A day later, the experimental group received an email

invitation to play a short game in the TIIM app twice a day for the next three days. Each game took about 5 minutes. A day after the last training, both groups were invited to complete a final assessment by completing the IAT and parts of the initial questionnaire. This again took around 30 minutes. After the study, the control group also received access to the training to try it out for themselves.

Data analysis

Data preparation

First, the APA 7 theme was applied to the R environment. Then, using RStudio (version 2024.12.1-563), datasets from the experimental and control group were imported from SoSci Survey. The binary CBM variable was created, whereby 0 = control and 1 = experimental. Following this, the two datasets were merged into a combined dataset. To apply intention to treat to this sample, participants of the experimental group were not filtered based on exposure to treatment. However, invalid IATs were removed if the response time exceeded 300ms for more than 10% of all responses (Greenwald et al., 2003, as cited in Impliziter Assoziationstest (IAT) *[SOSCISurvey]*, n.d.). Further, if participants' response time on one answer exceeded 10 seconds, this answer was removed. Following this, demographic data was displayed and an independent t-test was conducted to test for significant differences between the groups on age. The Chi-squared tests were conducted to test for significant differences between the groups on gender, nationality, educational level and English proficiency. Next, the total score of each scale was calculated by coding them numerically, computing the total mean for the SCS and summing the scores of the Psy-Flex and K10. Finally, both the pre- and post-measured D-scores according to Nosek et al. (2014) of the three brief IATs were extracted from the dataset from SoSci Survey. Following this, the pre-test D-scores of each brief IAT were averaged into one single D-score, since it is assumed that the three brief IATs measure implicit self-compassion on different dimensions. The same

was true for the post-test D-scores. To check whether there are significant differences between the groups from pre- to post-measurement on explicit and implicit self-compassion, psychological flexibility and distress, the difference scores were calculated and independent t-tests were performed. For each scale, the Cronbach's alpha was calculated for each pre- and post-measurement using the "psych" package and the "cronbach_alpha" function. Finally, a correlation matrix was generated for explicit and implicit self-compassion, psychological flexibility and baseline psychological distress.

Analyses conducted

Firstly, to investigate the test-retest reliability, the averaged combined d-scores of the pre- and post-measurements were correlated by computing the intraclass correlation coefficient (ICC). The second research question was tested by calculating the Pearson correlation for implicit and explicit self-compassion. To answer the third research question, a linear mixed effects model was constructed whereby CBM was fixed. Further, there were two levels of time on implicit self-compassion, and the participants were the random factor. Fourth, a mediation analysis was conducted, in which implicit self-compassion was the mediator, CBM the independent variable and psychological flexibility the dependent variable. Beforehand, the assumptions of linearity, normality and homoscedasticity were checked. Linearity was checked by using the "plot" function. Homoscedasticity and Normality were accounted for using bootstrapping ("boot" function) and robust standard error ("hc=4"-function). The mediation analysis was performed using PROCESS for R by Hayes (2020) using "model = 4". Lastly, a moderation analysis was conducted using the "lm" function and "anova". Here, the moderator was baseline psychological distress, the independent variable CBM, and psychological flexibility, the dependent variable. Same as with the mediation analysis, beforehand, all assumptions were checked. Next to the moderation analysis, a

simple slope analysis was conducted and visualised using the "ggplot2" package and the "ggplot" function. The full R-Script is documented in Appendix B.

Table 2

Comparison of three brief implicit association test items, except the Me/Furniture items, between the current study and Koop's study (2024)

category: Compassion			category: Criticism		
Dimension	Current study items	Koop's study items	Dimension	Current study items	Koop's study items
K	Loving	Loving	J	Judgement	Judgement
K	Kindness	Kindness	J	Unforgiving	Cold-hearted
K	Tolerance	Tolerance	J	Intolerance	Intolerance
K	Gentle		J	Critical	
K	Forgiving		J	Rejection	
K	Accepting		J	Disapprove	
CH	Shared Struggles	Shared Struggles	I	Isolation	Isolation
CH	Common Humanity	Shared Feelings	I	Inferior	Sense of Inferiority
CH	Involved		I	Close-minded	
CH	Open-minded		I	Failure	
M	Balanced Emotions	Balanced Emotions	I	Disconnect	
M	Balanced Perspective	Balanced Perspective	OI	Fixation on Flaws	Fixation on Flaws
M	Mindfulness		OI	Inadequate	Consumed by Inadequacy
M	Reflective		OI	Overidentification	
M	Present		OI	Doubt	

M	Awareness	OI	Overwhelmed
		OI	Catastrophizing

Notes. K, CH and M represent Kindness, Common Humanity and Mindfulness, while J, I and OI represent Judgement, Isolation and Overidentification.

Figure 3

An example of a cognitive bias modification task whereby the two categories Compassion/Me and Criticism/Furniture, and an item to be assigned, are visible.

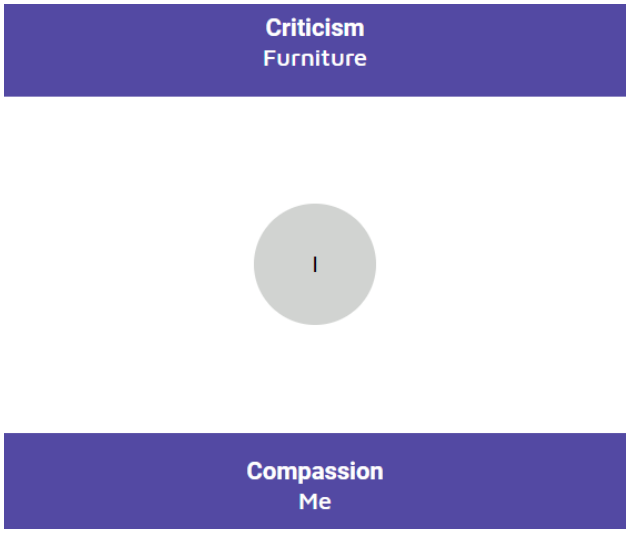


Figure 4

An example of a correct assignment of the item to the correct category within the cognitive bias modification

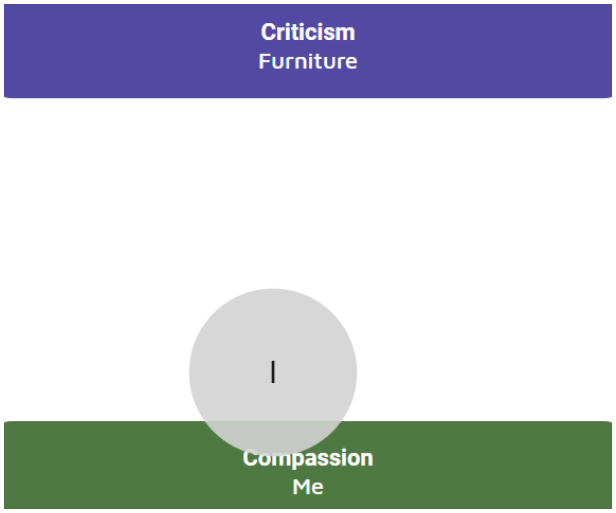
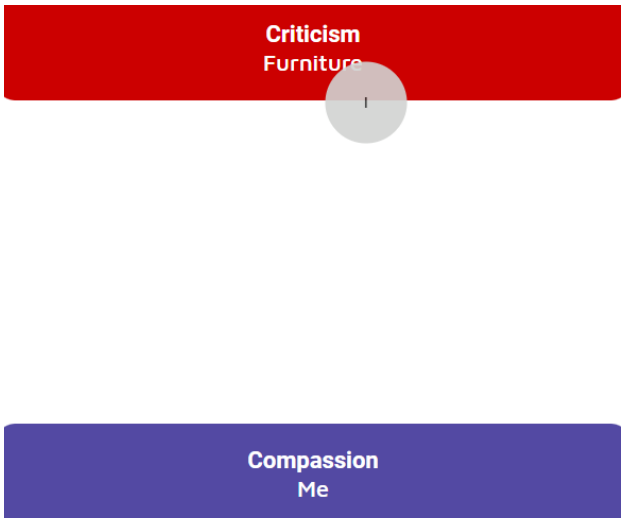


Figure 5

An example of an incorrect assignment of an item into the wrong category within the cognitive bias modification



Results

Data adjustments

Before conducting the analyses, participants were excluded from the dataset if any of the three brief IATs were invalid. Besides that, two participants were excluded who did not consent to conducting the study or were identified as being the researchers through the indication of an age of "1". Further adjustments include the reversing of the items of the self-compassion scale belonging to the dimensions of self-judgement (1, 8, 11, 16, 21), overidentification (2, 6, 20, 24) and isolation (4, 13, 18, 25).

Descriptive statistics

The mean levels of explicit self-compassion in the control and experimental group, both at pre- and post-measurement, were moderate, as visible in **Table 3**, since the scores lied between 2.5-3.5 (Neff, 2003). Though the total mean scores were moderate, there was a significant difference between the groups from pre- to post-measurement (t (39.6) = 2.14, $p <$ .05). Besides this significant difference, no other significant differences in the other variables from pre- to post-measurement were found.

Concerning psychological flexibility of the control and experimental group, both at pre- and post-measurement the total scores lay close to the average mean of 19.9 and within the first standard deviation of 4.9, indicating that both the psychological flexibility of the control and experimental group remain average at pre- and post-measurement (Gloster et al., 2021), see **Table 3**.

The psychological distress total score at baseline in the control group indicates a moderate likelihood of psychological distress since the total score lied between 25-29 (Kessler et al., 2003). In comparison, the experimental group's mean indicates a mild likelihood of psychological distress since the total score lies between 20-24 (Kessler et al.,

2003). Nevertheless, no significant difference between the groups was found (t (27) = .66, p = .52).

In this sample, the Cronbach's alphas of the Self-Compassion Scale at pre- and post measurements were .91 and .93, indicating excellent reliability. The Cronbach's alphas of the Psy-Flex Scale at pre- and post-measurements were .79 and .81, indicating that the scale has an acceptable to good reliability. The Cronbach's alpha of the Kessler Psychological Distress Scale was .88, indicating good reliability. Lastly, the IAT's pre- and post-measurements Cronbach's alpha were .53 and .42, indicating poor to unacceptable reliability (Flandorfer, 2023).

Next, the correlations between explicit and implicit self-compassion, psychological flexibility, and distress, both at baseline and post-intervention, were investigated. At baseline, unexpectedly, a significant negative correlation was found between explicit self-compassion and psychological flexibility (r = -.52, p < .001). A further unexpected significant positive correlation between explicit self-compassion and psychological distress was found (r = .43, p < .05). Further, an expected significant negative correlation was found between psychological flexibility and distress (r = - .51, p < .001). Post-intervention, explicit self-compassion correlated significantly negatively with psychological flexibility (r = - .58). All other correlations were non-significant and are indicated in **Table 4**.

Table 3

Comparison of the descriptive statistics of explicit and implicit self-compassion and psychological flexibility at pre- and post-measurements as well as psychological distress at baseline between the control (N=14) and experimental (N=28) group

	Pre-test						Post-test					
	Experimental			Control			Experimental			Control		
Variable	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*
Explicit Self-compassion	3.11	0.54	2.08 - 4	3.16	0.48	1.85 - 3.88	2.94	0.54	1.73 - 3.85	3.18	0.5	1.88 - 3.92
Implicit self-compassion	0.27	0.27	-.42 - .71	0.34	0.28	-.06 - .82	0.38	0.22	-.05 - .87	0.28	0.31	-.45 - .67
Psychological flexibility	20	3.75	13 - 27	21.1	2.84	17 - 27	20.2	3.7	13 - 27	20.2	3.7	16 - 26
Baseline distress	23.9	6.91	14 - 37	25.4	6.72	13 - 37						

Table 4

Correlation matrix of explicit and implicit self-compassion and psychological flexibility at pre- and post-measurements, as well as psychological distress at baseline (N=42)

At Baseline				
	Explicit self-compassion	Implicit self-compassion	Psychological flexibility	Baseline psychological distress
Explicit self-compassion	-			
Implicit self-compassion	-.09	-		
Psychological flexibility	-.52**	.04	-	
Baseline psychological distress	.43*	-.16	-.51**	-
Post Intervention				
	Explicit self-compassion	Implicit Self-compassion	Psychological flexibility	
Explicit self-compassion	-	.		
Implicit self-compassion	-.07	-		
Psychological flexibility	-.58**	-.01	-	

*$p < .05$, **$p < .001$.

Conducted analyses

Test-retest reliability of the three brief IATs

To investigate the first research question, concerning the test-retest reliability of the three brief IATs, an intraclass correlation coefficient was calculated. The intraclass correlation coefficient (ICC) was nonsignificant and poor [ICC = .09, $F(41,41) = 1.2$, p =

.29]. Accordingly, the hypothesis that "the test-retest reliability of the three brief IATs is at least moderate" was rejected.

Pearson correlation

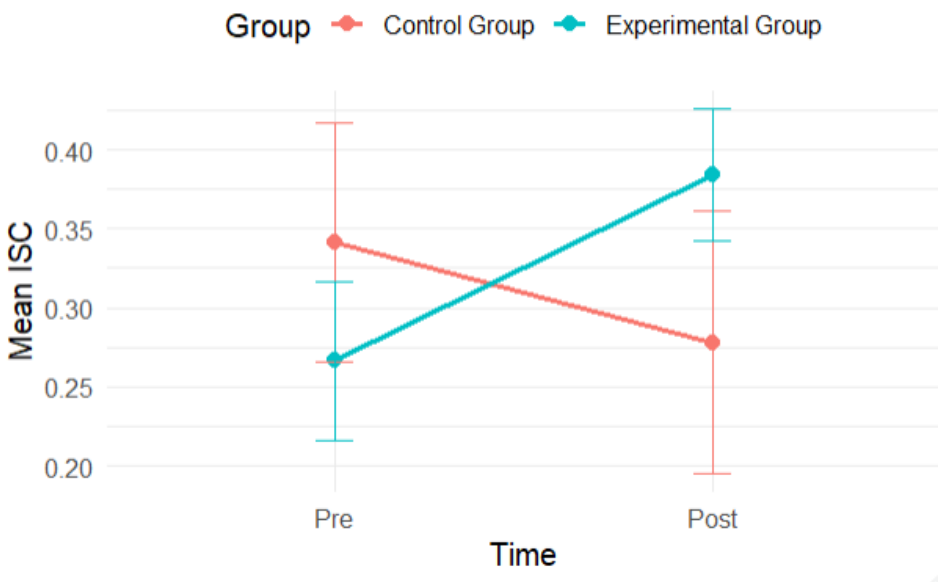
To investigate the second research question of whether explicit and implicit self-compassion correlate, a Pearson's correlation was conducted. Explicit and implicit self-compassion showed no significant correlation [r (40) = .02, p = .9]. Therefore, the hypothesis of expecting a significant moderate positive correlation between explicit and implicit self-compassion was rejected.

Linear mixed effects model

To answer the third research question, a linear mixed effects model was used. The model did not reveal a significant main effects of time [B = -0.06, SE = 0.09, t(40) = -0.68, p = .5] and of CBM [B = -0.07, SE = 0.09, t(78) = -0.87, p = .39], indicating that neither CBM nor Time contributed to a difference in implicit self-compassion. There was a tendency towards a significant positive CBM x Time interaction [B = 0.18, SE = 0.11, t (40) = 1.59, p = .12], as visible in **Figure 6**. The model fit for the fixed effects was not significant, yet appears to be marginally significant [F (1,40) = 2.51, p = .12]. The random intercept for participants was .34 with a standard deviation of .07, indicating substantial between-subject variability in baseline implicit self-compassion levels. Therefore, the hypothesis that CBM would be significantly positively affecting implicit self-compassion from pre- to post-measurement compared to the control group was rejected.

Figure 6

A Depiction of the change in implicit self-compassion from pre- to post-measurement for both the control (N=14) and experimental (N=28) groups



Mediation analysis

Before testing the fourth and fifth hypotheses using a mediation and moderation analysis, the assumptions of linearity were checked and met. The assumptions of homoscedasticity and normality were accounted for in the model through bootstrapping and robust standard errors.

The direct effect of CBM on psychological flexibility was negative and insignificant [B = -0.4, SE = 0.74, t (82) = -0.54, p = .59]. The effect of implicit self-compassion on psychological flexibility was positive and also insignificant [B = 0.19, SE = 1.44, t (80) = 0.13, p = .9]. There was no significant indirect effect of CBM via implicit self-compassion on psychological flexibility since 0 lay within the bootstrapped confidence interval [B = 0.003, SE = 0.1, CI [−.27, .17]]. Overall, the model fit was not significant [F (81) = 0.55, p = .58]. Thus, the hypothesis of implicit self-compassion fully mediating the relationship between CBM and psychological flexibility was rejected.

Moderation analysis

The direct effect of CBM on psychological flexibility was positive and not significant [B = 9.35, SE = 7.6, t (5,36) = 1.2, p = .23]. The effect of psychological distress on psychological flexibility was also not significant and positive [B = 0.1, SE = 0.1, t (5,36) = 1, p = .32]. A tendency towards a negative significant interaction effect of CBM and psychological distress on psychological flexibility was found [B = -0.20, SE = 0.13, t (5,36) = -1.6, p = .13]. This interaction effect is visualised per condition in **Figures 7 and 8**. The overall model fit is significant and explains 52% of the variance in psychological flexibility [F (5,36) = 9.88, p < .001]. Thus, these results do not support the hypothesis that psychological distress significantly reduces the effects of CBM on psychological flexibility.

Figure 7

Simple slopes analysis outcome visualised for the moderating effect of psychological distress (PDlevel) on cognitive bias modification and psychological flexibility in the experimental group.

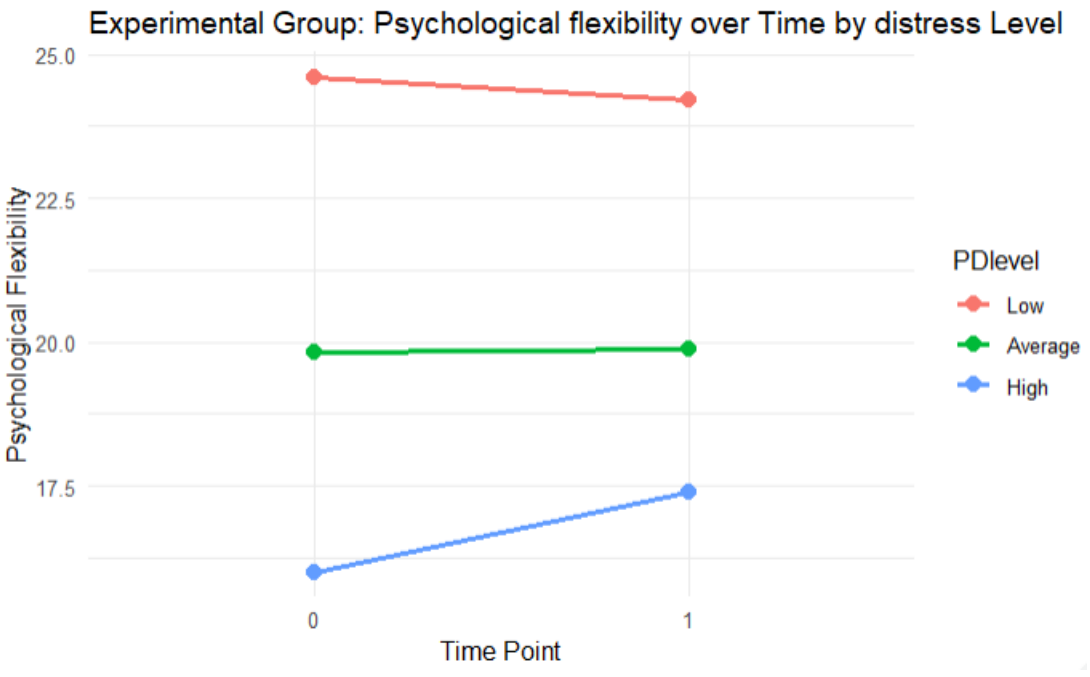
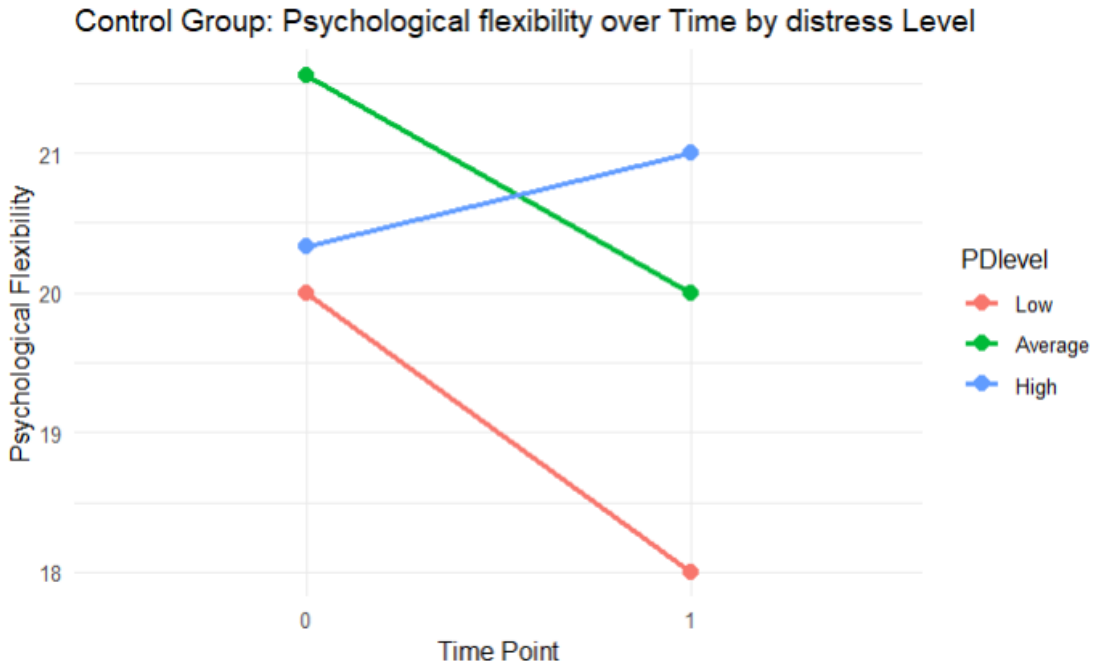


Figure 8

Simple slopes analysis outcome visualised for the moderating effect of psychological distress (PDlevel) on cognitive bias modification and psychological flexibility in the control group.



Discussion

Theoretical reflection and implications

The present study aimed to examine whether cognitive bias modification training targeting implicit self-compassion can enhance psychological flexibility and be explained by implicit self-compassion mediating the relationship. Furthermore, it explored whether psychological distress moderates the relationship between CBM and psychological flexibility. Additionally, this study sought to refine the measurement of implicit self-compassion by adapting Koop's (2024) single-category IAT into three brief IATs, each addressing a distinct dimension of self-compassion. This approach aimed to capture the construct more comprehensively and improve reliability.

Overall, the psychometric quality of the revised three brief self-compassion implicit association tests was insufficient and potentially explained the null findings. Further, no correlation between explicit and implicit self-compassion was found, suggesting that the implicit construct was not captured accurately, despite the implicit and explicit constructs' tendency to correlate moderately (Greenwald et al., 2021; Hofmann et al., 2005; Nosek, 2007; Nosek et al., 2007). A marginal training effect of cognitive bias modification on psychological flexibility was observed. However, no evidence was found for the cognitive bias modification effect on psychological flexibility to be mediated by improved implicit self-compassion or moderated by baseline psychological distress. These findings are discussed concerning the hypotheses and the broader implications of this intervention and the measurement of implicit self-compassion.

Regarding the first hypothesis about the test-retest reliability of the three brief IATs, the reliability was not at least moderate but very weak and not significant. This is not in alignment with the literature since brief IATs tend to have similar reliability to standard IATs of around .50 (Sriram & Greenwald, 2009). However, it may be that the combination of

multiple brief IATs into one composite D-score resulted in inconsistencies or noise that led to overall lower reliability. Though the post hoc sensitivity analysis of one brief IAT did not yield different results in reliability compared to the three brief IATs (see Appendix C), it may be that merging of the D-scores has not been the issue per se. Nevertheless, a multidimensional IAT that accounts for multiple dimensions within a construct has been shown to reach higher reliability (Gattol et al., 2011; Vaughn et al., 2011), providing a more robust measure for implicit self-compassion in future research.

Regarding the second hypothesis, no moderate positive correlations between explicit and implicit self-compassion were detected. This is counter to expectation since explicit and implicit constructs tend to correlate moderately and positively (Greenwald et al., 2021; Hofmann et al., 2005; Nosek, 2007; Nosek et al., 2007). According to the dual processing model, implicit and explicit attitudes relate even if they are distinct processes (De Paul Savanimuthu, 2024; Hofmann et al., 2005; Nosek et al., 2007; Sowder, 2024). However, this was not supported by the current study. Interestingly, this result aligns with the study by Sowder (2024), who also reported a not significant weak correlation between explicit and implicit self-esteem. Although self-esteem and self-compassion differ, such as self-esteem being bound to performance and self-evaluation, and self-compassion emphasising self-acceptance and resilience, they are both self-related constructs that promote mental health (Arslan, 2024; Neff, 2022; Marshall & Brockman, 2016; Moreno, 2023). An explanation for the absence of a correlation is that self-compassion is a metacognitive and abstract construct that may not be adequately captured using single words, even when selecting more homographs, such as “Gentle” and “Forgiving”, in an IAT. Neff‘s model includes dimensions that involve context, self-reflection and emotional awareness, which cannot be easily categorised into isolated words (Meissner et al., 2019). For instance the fifth item of the SCS by Neff (2003) “I try to be loving towards myself when I’m feeling emotional pain.” was

reduced to the stimuli “loving” in the IAT, which does not include the context of emotional pain or the attempt behind being loving to oneself in such a situation. Accordingly, the brief IATs may not have fully captured the dimensions of implicit self-compassion as intended, potentially. Through this, it may be that implicit self-compassion, as such, was not trained using CBM but a slightly different construct, such as implicit self-esteem or implicit self-worth. These constructs overlap with self-compassion (Neff, 2022) but are less cognitively complex and more related to core self-evaluations, such as gaining a sense of worthiness or goodness when pairing the self with compassionate words. Thus, the CBM might have shifted implicit attitudes towards the self without aligning close enough with the nuanced explicit self-compassion construct.

Concerning the third research question, a tendency towards a significant effect of the CBM and time interaction was detected, yet it does not underline the effectiveness of the current intervention design. Nevertheless, the tendency towards significance raises questions concerning the intervention design and whether a longer period of training could result in a significant intervention effect in which CBM increases implicit self-compassion across time. In a study by Beard (2011) at least eight sessions of two administrations per week of CBM were required until a notable effect on social anxiety was detected at two weeks of follow-up. In comparison, in a study by Eberl et al. (2013), after the sixth training, the strongest intervention effect was discovered for alcohol-related cognitive bias modification, and minor improvements were still visible at the twelfth session. In the current study, however, six sessions took place within the period of three days, yet there were lacking group differences and significant effects. Therefore, it may be that, though six sessions could yield the strongest effects, as in the study by Eberl et al. (2013), eight sessions might be required for the current study to reach such strong effects, as in the study by Beard (2011). Thus, it seems recommendable to investigate the necessary length of self-compassion CBM to gain the

strongest effects. Overall, the tendency towards a positive effect matches the expectation of the intervention‘s influence on implicit self-compassion, whereby training would increase it.

The fourth hypothesis concerned the mediating effect of implicit self-compassion on the relationship between the CBM allocation and psychological flexibility. It was expected that implicit self-compassion would fully mediate the relationship since it is an integral part of the CBM construction within the current study. However, this mediation did not occur. This aligns with the study by Forscher et al. (2019), in which changes in implicit constructs do not necessarily result in changes in explicit ones, and no mediating effect of the implicit construct was found. Nevertheless, it might be that CBM was limited in variability due to the groups not being significantly different from one another, resulting in no effect in this relationship. Accordingly, a longer and more intense interventional period might have resulted in greater variability between the control and experimental groups, contributing to significant effects on psychological flexibility.

The final hypothesis suggests that psychological distress negatively moderates the relationship between CBM and psychological flexibility. This study does not confirm this, which is not in alignment with the study by Lukasik et al. (2019) in which psychological distress shows impairing effects on executive functioning and attentional control that is necessary for the completion of cognitive tasks such as CBM (Vrijsen et al., 2024). Though there is no significant moderating effect, there is a tendency towards marginally significant effect, suggesting, similarly to the third hypothesis, that a longer intervention period might have been necessary to discover significant effects. Besides, it may be that the moderation analysis was underpowered since to detect a small interaction effect, according to the “G*Power 3” tool by Faul et al. (2007), a sample size of 395 is required. However, the sample size of the current study was 42. Accordingly, replicating this study with a larger

sample size and a longer intervention period may contribute to the detection of a moderating effect of psychological distress.

Limitations and strengths of the study

A great limitation of the current study is that the three brief IATs might not have captured implicit self-compassion as intended, not only through the low reliability of the IATs but mostly due to the low correlation between the implicit and explicit self-compassion. Due to the nature of IATs, the complexity of explicit self-compassion from the self-report scale was compressed into single words, possibly resulting in a loss of complexity and comparable meaning, leading to the capture of a slightly different construct instead of implicit self-compassion as intended.

Besides, it may be that the groups did not differ at post-intervention since the intervention period was rather short, namely two times per day for three days. According to Beard (2011), significant results can be detected after the eighth session of CBM, so in alignment with this study, it would have been after the fourth training day. Thus, it would make sense to advance the current study by enlarging the intervention period to at least four days of training if completed two times a day.

Similarly, it may be that the non-significant differences between the groups as well as between pre- and post-measurement may stem from some participants filling out the questionnaires in one go since the pre- and post questionnaires were not separate but the participants were instructed to pause the study after the pretest and come back via the posttest link. This was investigated post-hoc, and it was discovered that one fourth of all participants who completed the questionnaire did not pause after the pretest as instructed and continued filling out the posttest directly afterwards, indicating that naturally no big differences were able to be discovered through this. Accordingly, future research should ensure that there is no possibility of filling out the questionnaires in one go to reduce potential biases in the data.

Though there were a few structural limitations, the study showed notable strengths. This study explored a novel research area whereby implicit self-compassion was investigated and modified. Even if no significant changes were found, a tendency towards significance indicates the potential of the training on implicit self-compassion. Further, a tendency towards significance indicated that psychological distress might affect the relationship between the training and psychological flexibility, suggesting an exploration of the necessity to control for potential detrimental effects by introducing a stress-relieving exercise before the CBM in future studies.

Besides, the current study underlines the results from the study by Koop (2024) in which the complexity of implicit self-compassion might not be fully captured using an implicit association test, even when each dimension of self-compassion is assessed in separate brief IATs. This confirms the demand for utilising different implicit measurements that can capture implicit self-compassion in its complexity, such as the implicit relational assessment procedure (IRAP). The IRAP is a behavioural measure derived from the IAT and the Relational Evaluation Procedure, based on the Relational Frame Theory (Barnes-Holmes & Harte, 2022; Murphy et al., 2015). Instead of assuming implicit associations, the IRAP measures the strength of innate verbal relations through the participants' confirmation and disconfirmation of specific stimulus relations under time pressure (Barnes-Holmes & Harte, 2022; Murphy et al., 2015). The IRAP effect is identified through quick responses to consistent trials, such as "flower and pleasant", compared to inconsistent ones (Barnes-Holmes & Harte, 2022; Murphy et al., 2015). Compared to the IAT, the IRAP demonstrates predictive validity across several domains, such as attractiveness bias, social stereotyping and self-esteem (Barnes-Holmes & Harte, 2022; Murphy et al., 2015). Therefore, the IRAP might be a promising tool for future research aiming to assess implicit self-compassion more comprehensively.

Further recommendations

To continue measuring and training implicit self-compassion reliably, a different IAT design might be needed or a different implicit measurement that captures the metacognitive complexity of self-compassion, such as the Implicit Relational Assessment Procedure (Barnes-Holmes & Harte, 2022; Murphy et al., 2015). During the IRAP, participants would be presented with a series of brief trials on a computer screen, in which, in each trial, a label stimulus, such as “Me”, and a target stimulus, such as “compassionate” or “critical”, as well as two response options, such as “True” or “False” would be displayed. In consistent blocks, participants may be asked to affirm self-compassionate pairings, such as “Me”, “compassionate” and “True”, while denying uncompassionate ones, such as “Me”, “critical” and “False”. The opposite is required in the inconsistent blocks. The implicit self-compassion bias would be revealed through the response speed to the pairings in consistent blocks compared to the inconsistent ones.

Furthermore, for training implicit self-compassion, a cognitive bias modification of interpretation might be adequate since ambiguous situations and stimuli can be interpreted differently per individual (Matheson et al., 2019; Schoth & Liossi, 2017). Additionally, interpretation and perception are shaped by several factors such as personal experiences, expectations, attitudes and beliefs (Schoth & Liossi, 2017). Accordingly, to train individuals into interpreting ambiguous situations and stimuli in a more self-compassionate manner, the CBM for interpretation could be applied. During the training, the individuals would have to interpret ambiguous situations in a self-compassionate manner through the presence of a compassionate resolution in the last part of the ambiguous text, similar to the study by Matheson et al. (2019), in which the goal was to reduce eating disordered interpretations and increase adaptive ones. Through this, the metacognitive nature of self-compassion may be trained implicitly in a similarly complex manner.

For investigating the effectiveness of the CBM training, one could recreate this study and prolong the training to at least eight sessions (Beard, 2011) since six sessions only yielded marginally significant results. Moreover, the inclusion of a bigger sample size might support the detection of significant effects. In connection with this, it would be interesting to test which frequency of training may yield better training results by creating two experimental groups, of which one trains once a day and the other twice or more times a day. By comparing the experimental groups to the passive control group, an investigation of the required training period and frequency is possible. Then, to further ensure that the intervention effect lasts, follow-up measures can be conducted. In this way, CBM can be explored as a low-cost, high-scale intervention for enhancing implicit self-compassion and psychological flexibility.

Conclusion

The current study aimed to examine the effects of the CBM on implicit self-compassion and psychological flexibility, as well as the mechanism of implicit self-compassion on this relationship. The study further aimed to investigate the moderating effects of psychological distress on CBM and psychological flexibility. Though the results were insignificant, the tentative interpretations of the results contribute to the growing evidence for the capture and modifiability of implicit self-compassion, a novel area of research. A lack of correlations between explicit and implicit self-compassion suggests that the IAT did not fully capture the complexity of explicit self-compassion to reliably measure implicit self-compassion, potentially explaining the null findings and requesting the use of methodologies that allow the capture of such complexity, such as an IRAP. The lack of change in psychological flexibility and the moderating effect of psychological distress, counter to expectation, underline the necessity of longer or more intense interventions to establish the long-term impact of CBM on implicit self-compassion and its effects on well-being-related

constructs such as psychological flexibility. Despite the limitations of the study, such as the detected low IAT's reliabilities, the short training period, and the possible bias introducing questionnaires-design, the study contributed valuable insights into the areas of improvement for creating a low-cost, large-scale intervention to improve self-compassion and psychological flexibility.

Reference List

About the IAT. (2019, August 17). Iatgen. https://iatgen.wordpress.com/about-iat/

Arslan, G. (2024). Unlocking the Power of Self-Compassion and Psychological Flexibility: enhancing emotional health, subjective wellbeing, and quality of life in college students. *Studia Psychologica, 66*(1), 50–65. https://doi.org/10.31577/sp.2024.01.890

Arslan, G., Bişkin, S. Ö., & Kocaayan, F. (2025). Adverse childhood experiences, self-compassion, psychological flexibility, and posttraumatic stress disorder. *Children and Youth Services Review, 169*. https://doi.org/10.1016/j.childyouth.2024.108109

Barnes-Holmes, D., & Harte, C. (2022). The IRAP as a measure of Implicit Cognition: a case of Frankenstein's monster. *Perspectives on Behavior Science, 45*(3), 559–578. https://doi.org/10.1007/s40614-022-00352-z

Beard, C. (2011). Cognitive bias modification for anxiety: current evidence and future directions. *Expert Review of Neurotherapeutics*, *11*(2), 299–311. https://doi.org/10.1586/ern.10.194

Da Silva, B. F. P., Santos-Vitti, L., & Faro, A. (2021). Kessler Psychological Distress scale: internal structure and relation to other variables. *Psico-USF*, *26*(1), 91–101. https://doi.org/10.1590/1413-82712021260108

De Paul Savarimuthu, V., Joseph, D. a. M., & Irulandi, M. (2024). Emotion Regulation through Cognitive Strategies. *In IntechOpen eBooks*. https://doi.org/10.5772/intechopen.1006361

Eberl, C., Wiers, R. W., Pawelczack, S., Rinck, M., Becker, E. S., & Lindenmeyer, J. (2013). Implementation of Approach Bias Re-Training in Alcoholism-How Many Sessions

are Needed? *Alcoholism Clinical and Experimental Research, 38*(2), 587–594. https://doi.org/10.1111/acer.12281

Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Flandorfer, P. (2023, January 17). Cronbachs Alpha berechnen und interpretieren. *Scribbr*. https://www.scribbr.de/statistik/cronbachs-alpha/

Forscher, P. S., Lai, C. K., Axt, J. R., Ebersole, C. R., Herman, M., Devine, P. G., & Nosek, B. A. (2019). A meta-analysis of procedures to change implicit measures. *Journal of Personality and Social Psychology*, *117*(3), 522–559. https://doi.org/10.1037/pspa0000160

Gattol, V., Sääksjärvi, M., & Carbon, C. (2011). Extending the Implicit Association Test (IAT): assessing consumer attitudes based on Multi-Dimensional Implicit Associations. *PLoS ONE*, *6*(1), e15849. https://doi.org/10.1371/journal.pone.0015849

Geerts, J. A., Siemerink, E. J. M., Sniehotta, F. F., Loman, L. J. M., Bode, C., & Pieterse, M. E. (2024). A protocol for a feasibility study of Cognitive Bias Modification training (IVY) countering fatigue in people with breast cancer. *Pilot and Feasibility Studies*, *10*(1). https://doi.org/10.1186/s40814-024-01571-8

Gloster, A. T., Block, V. J., Klotsche, J., Villanueva, J., Rinner, M. T. B., Benoy, C., Walter, M., Karekla, M., & Bader, K. (2021). Psy-Flex: A contextually sensitive measure of psychological flexibility. *Journal of Contextual Behavioral Science, 22*, 13–23. https://doi.org/10.1016/j.jcbs.2021.09.001

Greenwald, A. G., Brendl, M., Cai, H., Charlesworth, T., Cvencek, D., Dovidio, J. F., Friese, M., Hahn, A., Hehman, E., Hofmann, W., Hughes, S., Hussey, I., Jordan, C., Jost, J., Kirby, T., Lai, C. K., Lang, J., Lindgren, K. P., Maison, D., Ostafin, B. D., Rae, J. R., Ratliff, K., Smith, C. T., Spruyt, A., & Wiers, R. W. (2019). The Implicit Association Test at age 20: What is known and what is not known about implicit bias. *University of Washington*. Retrieved from https://psyarxiv.com/bf97c

Greenwald, A. G., Brendl, M., Cai, H., Cvencek, D., Dovidio, J. F., Friese, M., Hahn, A., Hehman, E., Hofmann, W., Hughes, S., Hussey, I., Jordan, C., Kirby, T. A., Lai, C. K., Lang, J. W. B., Lindgren, K. P., Maison, D., Ostafin, B. D., Rae, J. R., Ratliff, K. A., Spruyt, A. & Wiers, R. W. (2021). Best research practices for using the Implicit Association Test. *Behavior Research Methods, 54*(3), 1161–1180. https://doi.org/10.3758/s13428-021-01624-3

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology, 74*(6), 1464–1480. https://doi.org/10.1037/0022-3514.74.6.1464

Hayes, A. F. (2020). PROCESS macro for SPSS, SAS, and R. *Processmacro*. https://www.processmacro.org/index.html

Hofmann, W., Gschwendner, T., Nosek, B. A., & Schmitt, M. (2005). What moderates implicit—explicit consistency? *European Review of Social Psychology, 16*(1), 335–390. https://doi.org/10.1080/10463280500443228

Impliziter Assoziationstest (IAT) [SOSCISurvey]. (n.d.). https://www.soscisurvey.de/help/doku.php/de:create:questions:iat

Kakoschke, N., Kemps, E., & Tiggemann, M. (2017). Approach bias modification training and consumption: A review of the literature. *Addictive Behaviors, 64*, 21–28. https://doi.org/10.1016/j.addbeh.2016.08.007

Kämper, E., Katajavuori, N. N., & Asikainen, N. H. (2025). Effects of an ACT-based online intervention on university students' psychological flexibility, well-being and study skills. *Journal of University Teaching and Learning Practice*. https://doi.org/10.53761/pgsppe36

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S.-L. T., Manderscheid, R. W., Walters, E. E., & Zaslavsky, A. M. (2003). Screening for Serious Mental Illness in the General Population. *Arch Gen Psychiatry, 60*(2), 184–189. https://doi.org/10.1001/archpsyc.60.2.184

Kılıç, A., Hudson, J., Scott, W., McCracken, L. M., & Hughes, L. D. (2022). A 12-month longitudinal study examining the shared and unique contributions of self-compassion and psychological inflexibility to distress and quality of life in people with Type 2 Diabetes. *Journal of Psychosomatic Research, 155*. https://doi.org/10.1016/j.jpsychores.2022.110728

Koop, N. (2024). Hidden Self-Compassion : Psychometric Properties of a Novel Tool to Measure Implicit Self-Compassion [Master Thesis, University of Twente]. http://essay.utwente.nl/98353/1/Koop_MA_BMS.pdf

Lukasik, K. M., Waris, O., Soveri, A., Lehtonen, M., & Laine, M. (2019). The relationship of anxiety and stress with working memory performance in a large non-depressed sample. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00004

Leiner, D. J. (2024). SoSci Survey (Version 3.7.06) [Computer software]. Available at https://www.soscisurvey.de

Marshall, E., & Brockman, R. N. (2016). The relationships between Psychological Flexibility, Self-Compassion, and Emotional Well-Being. *Journal of Cognitive Psychotherapy, 30*(1), 60–72. https://doi.org/10.1891/0889-8391.30.1.60

Matheson, E., Wade, T. D., & Yiend, J. (2019). Utilising cognitive bias modification to remedy appearance and self-worth biases in eating disorder psychopathology: A systematic review. *Journal of Behavior Therapy and Experimental Psychiatry*, *65*. https://doi.org/10.1016/j.jbtep.2019.101482

Meissner, F., Grigutsch, L. A., Koranyi, N., Müller, F., & Rothermund, K. (2019). Predicting behavior with implicit measures: disillusioning findings, reasonable explanations, and sophisticated solutions. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.02483

Moreno, J. (2023). Self-Compassion and Psychological Flexibility: A Meta-Analysis of Relations. *Electronic Theses and Dissertations*. 3114. https://digitalcommons.memphis.edu/etd/3114

Murphy, C., Hussey, T., Barnes-Holmes, D. & Kelly, M. E. (2015). The Implicit Relational Assessment procedure (IRAP) and attractiveness bias. *Journal of Contextual Behavioral Science, 4*(4). 292 – 299. https://doi.org/10.1016/j.jcbs.2015.08.001

Mursalzade, G., Escriche-Martínez, S., Valdivia-Salas, S., Jiménez, T. I., & López-Crespo, G. (2025). Factors Associated with Psychological Flexibility in Higher Education Students: A Systematic Review. *Sustainability, 17*(12), 5557. https://doi.org/10.3390/su17125557

Neff, K. D. (2003). Development and validation of a scale to measure self-compassion. *Self and Identity*, *2*, 223–250. https://self-compassion.org/wp-content/uploads/2021/03/SCS-information.pdf

Neff, K. D. (2022). Self-Compassion: theory, method, research, and intervention. *Annual Review of Psychology, 74*(1), 193–218. https://doi.org/10.1146/annurev-psych-032420-031047

Nosek, B. A. (2007). Implicit–Explicit relations. *Current Directions in Psychological Science, 16*(2), 65–69. https://doi.org/10.1111/j.1467-8721.2007.00477.x

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2007). The Implicit Association Test at age 7: A methodological and conceptual review. In Automatic processes in social thinking and behavior. *Psychology Press*. 265 - 292. https://faculty.washington.edu/agg/pdf/Nosek%20&%20al.IATatage7.2007.pdf

Ong, C. W., & Eustis, E. H. (2023). Psychological Flexibility. In The Oxford Handbook of Acceptance and Commitment Therapy(pp. 169–171). *Oxford University Press.* https://doi.org/10.1093/oxfordhb/9780197550076.001.0001

Piao, X., Xie, J., & Managi, S. (2024). Continuous worsening of population emotional stress globally: universality and variations. *BMC Public Health, 24*(1). https://doi.org/10.1186/s12889-024-20961-4

Reihl, K. M., Hurley, R. A., & Taber, K. H. (2015). Neurobiology of Implicit and Explicit Bias: Implications for Clinicians. *Journal of Neuropsychiatry*, *27*(4), A6-253. https://doi.org/10.1176/appi.neuropsych.15080212

Schoth, D. E., & Liossi, C. (2017). A Systematic Review of Experimental Paradigms for Exploring Biased Interpretation of Ambiguous Information with Emotional and

Neutral Associations. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.00171

Sowder, E. (2024). Improving Implicit Self-esteem via a Targeted Mobile Cognitive Bias Modification Intervention [Master Thesis, University of Twente]. https://essay.utwente.nl/102758/1/Sowder_MA_BMS.pdf

Sriram, N., & Greenwald, A. G. (2009). The Brief Implicit Association test. *Experimental Psychology (Formerly Zeitschrift Für Experimentelle Psychologie)*, *56*(4), 283–294. https://doi.org/10.1027/1618-3169.56.4.283

Twente Intervention and Interaction Machine (TIIM) | Infohub | BMS Lab. (n.d.). Universiteit Twente. https://www.utwente.nl/en/bmslab/infohub/tiim/

Vaughn, E. D., Thomas, A., & Doyle, A. L. (2011). The Multiple Disability Implicit Association Test. *Rehabilitation Counseling Bulletin, 54*(4), 223–235. https://doi.org/10.1177/0034355211403008

Vrijsen, J. N., Grafton, B., Koster, E.H. W., Lau, J., Wittekind, C. E., Bar-Haim, Y., Becker, E. S., Brotman, M. A., Joormann, J., Lazarov, A., MacLeod, C., Manning, V., Pettit, J. W., Rinck, M., Salemink, E., Woud, M. L., Hallion, L. S. & Wiers, R. W. (2024). Towards implementation of cognitive bias modification in mental health care: State of the science, best practices, and ways forward. *Behaviour Research and Therapy 179*. https://doi.org/10.1016/j.brat.2024.104557

Williams, A. D., Blackwell, S. E., Holmes, E. A., & Andrews, G. (2013). Positive imagery cognitive bias modification (CBM) and internet-based cognitive behavioural therapy (iCBT) versus control CBM and iCBT for depression: study protocol for a parallel-

group randomised controlled trial. *BMJ Open, 3*(10), e004049. https://doi.org/10.1136/bmjopen-2013-004049

Woodfin, V., Molde, H., Dundas, I., & Binder, P. (2021). A randomized control trial of a brief Self-Compassion intervention for perfectionism, anxiety, depression, and body image. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.751294

Appendix A

AI Statement

During the preparation of this work, the author used ChatGPT and Word to check for redundancies in the text, spelling and grammatical mistakes. After using these tools, the author thoroughly reviewed and edited the content as needed, taking full responsibility for the content of the work.

Appendix B

Full R-script

```
##Masterthesis 2025

##Sara von Pruski

##21.04.2025


#load necessary packages

library(tidyverse)

library(janitor)

library(labelled)

library(psych)

library(readr)

library(dplyr)


#open datasets

experimental <- read_csv2("data_experimental_2025-04-21_10-58.csv", locale=

locale(decimal_mark = ","))

control <- read_csv2("data_control_2025-04-21_11-09.csv", locale= locale(decimal_mark =

","))


##data cleansing and preparation

#add new column for group allocation (CBM variable)

experimental <- experimental %>% mutate(Group= "EXP")

control <- control %>% mutate(Group="CON")
```

```
#bind datasets into one
Mdata <- bind_rows(experimental, control)
colnames(Mdata)

#move group allocation to front of dataset
Mdata <- Mdata %>% select(Group, everything())

#filter only participants that consented and that are 18 or older
CleanMdata <- Mdata[Mdata$BE03 == "I hereby confirm that I am 18 years old or older and
have read and understood the information. My participation in this study is voluntary.", ]
CleanMdata <- CleanMdata[CleanMdata$D101_01 >= 18, ]

#remove invalid IATs
CleanMdata <- CleanMdata %>% mutate(across(c(IA02DS, IA09DS, IA11DS, IA13DS,
IA14DS, IA15DS), ~ na_if(., -8)))
CleanMdata <- CleanMdata[complete.cases(CleanMdata[, c("IA02DS", "IA09DS",
"IA11DS", "IA13DS", "IA14DS", "IA15DS")]), ]

#calculating mean d-scores from T1 to T2 (Implicit self-compassion = ISC)
CleanMdata <- CleanMdata %>%
  mutate(ISC_D_Nos1 = rowMeans(select(., IA02DS, IA09DS, IA11DS)),
         ISC_D_Nos2 = rowMeans(select(., IA13DS, IA14DS, IA15DS)))

#move group allocation + D-scores to front of dataset
```

```
CleanMdata <- CleanMdata %>% select(Group, ISC_D_Nos1, ISC_D_Nos2, everything())

#remove participant that indicated 7th item of PF bc that is not supposed to exist and is very likely one of the researchers
CleanMdata <- CleanMdata[is.na(CleanMdata$PF01_07) & is.na(CleanMdata$PF02_07), ]

#binary CBM variable created
CleanMdata$CBM <- ifelse(CleanMdata$Group == "EXP", 1, 0)

##computing totalscores of the PF, SCS and PD
#SCS
  #reverse items
CleanMdata <- CleanMdata %>%
  mutate(across(c(SC01_01, SC01_08, SC01_11, SC01_16, SC01_21, SC01_04, SC01_13, SC01_18, SC01_25, SC01_02, SC01_06, SC01_20, SC01_24, SC02_01, SC02_08, SC02_11, SC02_16, SC02_21, SC02_04, SC02_13, SC02_18, SC02_25, SC02_02, SC02_06, SC02_20, SC02_24), ~ 6 - ., .names = "{.col}_rev"))
  #total mean score
SCitems1 <- c("SC01_01_rev", "SC01_02_rev", "SC01_03", "SC01_04_rev", "SC01_05", "SC01_06_rev", "SC01_07", "SC01_08_rev", "SC01_09", "SC01_10", "SC01_11_rev", "SC01_12", "SC01_13_rev", "SC01_14", "SC01_15", "SC01_16_rev", "SC01_17", "SC01_18_rev", "SC01_19", "SC01_20_rev", "SC01_21_rev", "SC01_22", "SC01_23", "SC01_24_rev", "SC01_25_rev", "SC01_26")
SCitems2 <- c("SC02_01_rev", "SC02_02_rev", "SC02_03", "SC02_04_rev", "SC02_05", "SC02_06_rev", "SC02_07", "SC02_08_rev", "SC02_09", "SC02_10", "SC02_11_rev",
```

```
"SC02_12", "SC02_13_rev", "SC02_14", "SC02_15", "SC02_16_rev", "SC02_17",
"SC02_18_rev", "SC02_19", "SC02_20_rev", "SC02_21_rev", "SC02_22", "SC02_23",
"SC02_24_rev", "SC02_25_rev", "SC02_26")
CleanMdata$SC1scale_mean <- rowMeans(CleanMdata[, SCitems1], na.rm = TRUE)
CleanMdata$SC2scale_mean <- rowMeans(CleanMdata[, SCitems2], na.rm = TRUE)

#PF
CleanMdata <- CleanMdata%>%
  mutate(PFtot1 = CleanMdata$PF01_01 + CleanMdata$PF01_02 + CleanMdata$PF01_03 +
CleanMdata$PF01_04 + CleanMdata$PF01_05 + CleanMdata$PF01_06,
         PFtot2 = CleanMdata$PF02_01 + CleanMdata$PF02_02 + CleanMdata$PF02_03 +
CleanMdata$PF02_04 + CleanMdata$PF02_05 + CleanMdata$PF02_06)

#PD
CleanMdata <- CleanMdata%>%
  mutate(PDtot1 = CleanMdata$PD01_01 + CleanMdata$PD01_02 + CleanMdata$PD01_03
+ CleanMdata$PD01_04 + CleanMdata$PD01_05 + CleanMdata$PD01_06 +
CleanMdata$PD01_07 + CleanMdata$PD01_08 + CleanMdata$PD01_09 +
CleanMdata$PD01_10 )

##demographics
library(janitor)
tabyl(CleanMdata, Group, D101_01) #age
tabyl(CleanMdata, Group, D104) #gender
tabyl(CleanMdata, Group, D105) #nationality
```

```
tabyl(CleanMdata, Group, D105_03) #other nationalities

tabyl(CleanMdata, Group, D102) # eduaction

tabyl(CleanMdata, Group, D107) # english proficiency


#t-test on demographics

t.test(D101_01~Group, data = CleanMdata)

table_gender <- table(CleanMdata$Group, CleanMdata$D104)

chisq.test(table_gender)

table_nat <- table(CleanMdata$Group, CleanMdata$D105)

chisq.test(table_nat)

table_ed <- table(CleanMdata$Group, CleanMdata$D102)

chisq.test(table_ed)

table_eng <- table(CleanMdata$Group, CleanMdata$D107)

chisq.test(table_eng)



##descriptive statistics

library(table1)

  #calculate means, sd's, ranges and medians for each variable and add it into a table:

library(dplyr)


CleanMdata %>%

  group_by(Group) %>%

  summarise(

    n = n(),
```

```
    SC1_Mean = mean(SC1scale_mean, na.rm = TRUE),
    SC1_SD = sd(SC1scale_mean, na.rm = TRUE),
    SC2_Mean = mean(SC2scale_mean, na.rm = TRUE),
    SC2_SD = sd(SC2scale_mean, na.rm = TRUE),
    ISC1_Mean = mean(ISC_D_Nos1, na.rm = TRUE),
    ISC1_SD = sd(ISC_D_Nos1, na.rm = TRUE),
    ISC2_Mean = mean(ISC_D_Nos2, na.rm = TRUE),
    ISC2_SD = sd(ISC_D_Nos2, na.rm = TRUE),
    PF1_Mean = mean(PFtot1, na.rm = TRUE),
    PF1_SD = sd(PFtot1, na.rm = TRUE),
    PF2_Mean = mean(PFtot2, na.rm = TRUE),
    PF2_SD = sd(PFtot2, na.rm = TRUE),
    PD1_Mean = mean(PDtot1, na.rm = TRUE),
    PD1_SD = sd(PDtot1, na.rm = TRUE)
  )

CleanMdata %>%
  group_by(Group) %>%
  summarise(
    n = n(),

    SC1_Min = min(SC1scale_mean, na.rm = TRUE),
    SC1_Max = max(SC1scale_mean, na.rm = TRUE),

    SC2_Min = min(SC2scale_mean, na.rm = TRUE),
```

```
  SC2_Max = max(SC2scale_mean, na.rm = TRUE),

  ISC1_Min = min(ISC_D_Nos1, na.rm = TRUE),
  ISC1_Max = max(ISC_D_Nos1, na.rm = TRUE),

  ISC2_Min = min(ISC_D_Nos2, na.rm = TRUE),
  ISC2_Max = max(ISC_D_Nos2, na.rm = TRUE),

  PF1_Min = min(PFtot1, na.rm = TRUE),
  PF1_Max = max(PFtot1, na.rm = TRUE),

  PF2_Min = min(PFtot2, na.rm = TRUE),
  PF2_Max = max(PFtot2, na.rm = TRUE),

  PD1_Min = min(PDtot1, na.rm = TRUE),
  PD1_Max = max(PDtot1, na.rm = TRUE)
 )

##cronbach's alphas for all scales
library(psych)
SCitemspre <- CleanMdata[c("SC01_01_rev", "SC01_02_rev", "SC01_03", "SC01_04_rev",
"SC01_05", "SC01_06_rev", "SC01_07", "SC01_08_rev", "SC01_09", "SC01_10",
"SC01_11_rev", "SC01_12", "SC01_13_rev", "SC01_14", "SC01_15", "SC01_16_rev",
"SC01_17", "SC01_18_rev", "SC01_19", "SC01_20_rev", "SC01_21_rev", "SC01_22",
"SC01_23", "SC01_24_rev", "SC01_25_rev", "SC01_26")]
```

```
cronbach_alpha<-alpha(SCitemspre)
print(cronbach_alpha)

SCitemspost <- CleanMdata[c("SC02_01_rev", "SC02_02_rev", "SC02_03",
"SC02_04_rev", "SC02_05", "SC02_06_rev", "SC02_07", "SC02_08_rev", "SC02_09",
"SC02_10", "SC02_11_rev", "SC02_12", "SC02_13_rev", "SC02_14", "SC02_15",
"SC02_16_rev", "SC02_17", "SC02_18_rev", "SC02_19", "SC02_20_rev", "SC02_21_rev",
"SC02_22", "SC02_23", "SC02_24_rev", "SC02_25_rev", "SC02_26")]
cronbach_alpha<-alpha(SCitemspost)
print(cronbach_alpha)

PFitemspre <- CleanMdata[c("PF01_01", "PF01_02", "PF01_03","PF01_04",
"PF01_05","PF01_06")]
cronbach_alpha<-alpha(PFitemspre)
print(cronbach_alpha)

PFitemspost <- CleanMdata[c("PF02_01", "PF02_02", "PF02_03","PF02_04",
"PF02_05","PF02_06")]
cronbach_alpha<-alpha(PFitemspost)
print(cronbach_alpha)

PDitems<-
CleanMdata[c("PD01_01","PD01_02","PD01_03","PD01_04","PD01_05","PD01_06",
"PD01_07","PD01_08","PD01_09","PD01_10")]
cronbach_alpha<-alpha(PDitems)
```

```
print(cronbach_alpha)

ISCitemspre <- CleanMdata[c("IA02DS", "IA09DS", "IA11DS")]
cronbach_alpha<-alpha(ISCitemspre)
print(cronbach_alpha)

ISCitemspost<-CleanMdata[c("IA13DS", "IA14DS", "IA15DS")]
cronbach_alpha<-alpha(ISCitemspost)
print(cronbach_alpha)

##correlating the variables
install.packages("Hmisc")
library(Hmisc)
res <- rcorr(as.matrix(CleanMdata[, c("SC1scale_mean", "SC2scale_mean", "ISC_D_Nos1",
"ISC_D_Nos2", "PFtot1", "PFtot2", "PDtot1", "CBM")]))
res$r
res$P

##T-tests for looking for significant changes between the groups
CleanMdata <- CleanMdata %>%
  mutate(
    SC_diff = SC2scale_mean - SC1scale_mean,
    ISC_diff = ISC_D_Nos2 - ISC_D_Nos1,
    PF_diff = PFtot2 - PFtot1
  )
```

```
t.test(SC_diff ~ CBM, data = CleanMdata)

t.test(ISC_diff ~ CBM, data = CleanMdata)

t.test(PF_diff ~ CBM, data = CleanMdata)

t.test(PDtot1 ~ CBM, data = CleanMdata) #--> no changes found


##inferential statistics

##answering the 1st RQ - test-retest reliability (ICC)

ICC_ISC <- CleanMdata[, c("ISC_D_Nos1", "ISC_D_Nos2")]

ICC(ICC_ISC) #not significant, ICC .086-.160; interval includes negatives (-0.22-0.55)


##answering the 2nd RQ - ICC of implicit and explicit SC

cor.test(CleanMdata$ISC_D_Nos1, CleanMdata$SC1scale_mean, method = "pearson")

#--> no correlation, very high p-value, not significant


##answering the 3rd RQ - lme model

install.packages("lmerTest")

library(lmerTest)

model <- lmer(ISC_D_Nos ~ CBM * Time + (1 | ID), data = CleanMdata_long)

summary(model)

anova(model)


  # First, make sure CBM and Time are treated as factors for plotting

CleanMdata_long <- CleanMdata_long %>%

  mutate(CBM = factor(CBM, labels = c("Control Group", "Experimental Group")),
```

```
        Time = factor(Time, labels = c("Pre", "Post")))


ggplot(CleanMdata_long, aes(x = Time, y = ISC_D_Nos, group = CBM, color = CBM)) +
  stat_summary(fun = mean, geom = "line", size = 1.2) +
  stat_summary(fun = mean, geom = "point", size = 3) +
  stat_summary(fun.data = mean_se, geom = "errorbar", width = 0.1) +
  labs(
    title = "Implicit Self-Compassion Over Time by Group",
    x = "Time",
    y = "Mean ISC",
    color = "Group"
  ) +
  theme_minimal(base_size = 14) +
  theme(legend.position = "top")


##answering the 4th RQ - mediation analysis
  #pivot necessary columns into long format
CleanMdata$ID <- 1:nrow(CleanMdata)
library(tidyr)
CleanMdata_long <- CleanMdata %>%
  pivot_longer(
    cols = c(ISC_D_Nos1, ISC_D_Nos2, PFtot1, PFtot2),
    names_to = c(".value", "Time"),
    names_pattern = "(.*)(1|2)"
  ) %>%
```

```
  mutate(
    Time = as.numeric(Time) - 1  # 0 = pre, 1 = post
  )


  ##testing the assumptions for the mediation analysis 1:
    #comprehensive test:
      #replicate model used in Process for mediation:
        #CBM on ISC:
model.m1<- lm(CBM~ISC_D_Nos, data= CleanMdata_long)
summary(model.m1)


        #ISC on PF:
model.m2<- lm(ISC_D_Nos~PFtot, data= CleanMdata_long)
summary(model.m2)


        #CBM on PF:
modeldir1<- lm (CBM~PFtot, data = CleanMdata_long)
summary(modeldir1)


  #testing linearity between Time and ISC + Time and PF:
plot(CleanMdata_long$Time, CleanMdata_long$ISC_D_Nos)
abline(lm(ISC_D_Nos ~ Time, data = CleanMdata_long), col = "red")


plot(CleanMdata_long$Time, CleanMdata_long$PFtot)
abline(lm(PFtot ~ Time, data = CleanMdata_long), col = "blue")
```

```
#load PROCESS for R version 4.3.1 by Andrew F. Hayes using download link on
www.processmacro.org
##mediation analysis (Homoscedasticity and Normality are accounted for in this):
process(data = CleanMdata_long, y="PFtot", x="CBM", m=c("ISC_D_Nos"), cov = "Time",
model=4, describe =1, stand =1, contrast=1, modelbt=1, boot = 10000, seed = 424272, hc=4)

##answering the 5th RQ - moderation analysis
  ##testing the assumptions for the moderation analysis:
    #testing linearity between Time and PD:
plot(CleanMdata_long$Time, CleanMdata_long$PDtot1)
abline(lm(PDtot1 ~ Time, data = CleanMdata_long), col = "blue")

##moderation analysis
outmodMAS <-lm(PFtot2~CBM+PFtot1+CBM:PFtot1 + PDtot1 + CBM:PDtot1, data=
CleanMdata)
summary(outmodMAS)
anova(outmodMAS)

#plot Simple Slopes:
Slopesdata<- CleanMdata_long
Slopesdata$PDlevel <- with(Slopesdata,
                           cut(PDtot1,
                              breaks = c(-Inf, mean(PDtot1)-sd(PDtot1),
                                         mean(PDtot1)+sd(PDtot1), Inf),
                              labels = c("Low", "Average", "High")))
```

```
library(ggplot2)
library(dplyr)
ggplot(subset(Slopesdata, Slopesdata$Group == "CON"),
       aes(x = as.factor(Time), y = PFtot, color = PDlevel, group = PDlevel)) +
  stat_summary(fun = mean, geom = "line", size = 1.2) +
  stat_summary(fun = mean, geom = "point", size = 3) +
  labs(title = "Control Group: Psychological flexibility over Time by distress Level",
       x = "Time Point", y = "Psychological Flexibility") +
  theme_minimal()

ggplot(subset(Slopesdata, Slopesdata$Group == "EXP"),
       aes(x = as.factor(Time), y = PFtot, color = PDlevel, group = PDlevel)) +
  stat_summary(fun = mean, geom = "line", size = 1.2) +
  stat_summary(fun = mean, geom = "point", size = 3) +
  labs(title = "Experimental Group: Psychological flexibility over Time by distress Level",
       x = "Time Point", y = "Psychological Flexibility") +
  theme_minimal()


#post hoc sensitivity analysis:
  ##calculating mean d-scores from T1 to T2 for Kindness a dimension of implicit self-
compassion
Posthocdata <- CleanMdata %>%
  mutate(KinDnos1 = rowMeans(select(., IA02DS)),
         KinDnos2 = rowMeans(select(., IA13DS)))
```

```
library(psych)

ICC_Kin <- Posthocdata[, c("KinDnos1", "KinDnos2")]

ICC(ICC_Kin) #not significant, ICC .086-.160; interval includes negatives (-0.22-0.55)


#view who did the intervention in one go:

View(CleanMdata[, c("STARTED", "LASTDATA")])
```

Appendix C

Post-hoc sensitivity analysis - test-retest of one of the three brief IATs

Since the reliability of the three brief IATs was poor, a post-hoc sensitivity analysis was conducted to investigate the reliability. The outcome of this analysis was not different from the calculations using the averaged D-score of the three brief IATs. In this analysis, the dimension of kindness was investigated and resulted in an insignificant and poor ICC [ICC = .18, $F(42,41) = 1.4$, $p = .12$]. Thus, a single dimension is not more reliable compared to an averaged D-score from the three dimensions, so it can be assumed that no wrong conclusions were drawn due to the merging of the three variables.