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The building blocks of emotion regulation flexibility: correlational and causal evidence for the influence of sensitive classification of emotional intensity on flexible strategy selection

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ABSTRACT

Conceptual accounts define Emotion Regulatory Flexibility as composed of two sequential elements: (a) classification of affective contexts that is sensitive to their varying nature (b) flexible selection of regulatory strategies that matches varying affective contexts. Despite conceptual agreement, existing evidence focuses on the second element, leaving evidence for the first element and for the relationship between elements indirect. We provide correlational and causal evidence for the role of sensitive classification of emotional intensity, a central contextual variable, on flexible behavioural selection between distraction and reappraisal regulatory strategies. Confirming the correlational hypothesis, across subjects, trials involving sensitive classification of emotional intensity (vs. insensitive classification), were related to higher flexible selection between strategies. Confirming the causal hypothesis, experimentally providing information on sensitive emotional intensity classification to one group (vs. no-information group), led to increased flexible selection from before to after the manipulation. Broad implications for basic and applied science are discussed.

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Imagine sitting on the dentist chair, once for a routine dental cleaning procedure, and again for a complex wisdom tooth extraction. Will classifying the dental cleaning context as mildly intense and the tooth extraction context as highly intense, be associated with more flexible and adaptive selection between emotion regulatory strategies? Moreover, suppose that during the medical informed consent phase, your dentist provides you with information regarding the expected intensity of the two unpleasant contexts based on her vast experience with prior patients. Will the provided negative intensity information about the contexts, result in more flexible selection between regulatory strategies?

The aforementioned scenarios capture the essence of Emotion Regulation Flexibility, a construct that is central across numerous conceptual models (Aldao et al., 2015; Bonanno et al., 2024; Hollenstein et al., 2013; Kalokerinos & Koval, 2024; Kashdan & Rottenberg, 2010). Emotion Regulation Flexibility captures the general idea that to adaptively react to dynamically changing environment, people first need to classify the different contexts they are in, and then match their regulatory behavioural efforts to these differing contexts. Within the broad emotion regulation flexibility construct, *regulatory selection flexibility* is perhaps the most studied (Matthews et al., 2021 for a meta-analysis; Sheppes, 2020, 2024 for reviews), involving two crucial and sequential elements: (a) classification of affective contexts that is sensitive to their varying nature, followed by (b) flexible selection of regulatory strategies that

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matches varying affective contexts (Sheppes, 2024 for review).

While the regulatory selection flexibility construct clearly defines two sequential elements that are required to reach adaptive behaviour, existing empirical studies provided support only for the second element. Evidence for the first element and for the relationship between the two elements is currently sparse and indirect (Kalokerinos & Koval, 2024).

Multiple studies examining the second element of regulatory selection flexibility tested flexible behavioural selection between two central regulatory strategies when facing affective contexts that vary on a central emotional intensity factor (Sheppes, 2024; Sheppes et al., 2011 for reviews). The two regulatory strategies mostly studied – distraction and reappraisal – vary on a central disengagement-engagement continuum that represents differential degrees of affective information processing (Ochsner & Gross, 2005). Disengagement distraction involves early diverting attention away from processing emotional information, by producing unrelated neutral thoughts (e.g. Van Dillen & Koole, 2007). Engagement reappraisal involves early attentional engagement with emotional information, prior to a late modulation of meaning of affective information (Sheppes, 2024 for reviews). The varying levels of emotional intensity (high versus low) have been experimentally manipulated with a variety of unpleasant stimuli including negative words and sentences, negative images and sounds, and electric shocks (Sheppes, 2024 for reviews).

Findings supporting the second element of regulatory selection flexibility have repeatedly demonstrated that healthy individuals flexibly select between distraction and reappraisal to efficiently regulate varying emotional intensities (Matthews et al., 2021 for a meta-analysis; Sheppes, 2024 for reviews). Specifically, in affective contexts that are considered of high intensity, where disengagement distraction provides strong immediate modulation, distraction is predominantly chosen relative to reappraisal. However, in affective contexts that are considered of low intensity, where both strategies equally modulate affect in the short-term but only reappraisal offers long term benefits, reappraisal is predominantly chosen relative to distraction.

Furthermore, recent studies demonstrated that the aforementioned flexible selection between distraction and reappraisal to varying intensity levels, has important consequences for adaptive functioning and psychopathology. Specifically, flexible regulatory selection resulted in successful modulation of negative affect (Specker et al., 2023; Specker & Nickerson, 2023) and was impaired in psychopathology (Fine et al., 2023; Levy-Gigi et al., 2016).

The aforementioned studies support the second element, providing strong evidence for flexible selection in accordance with varying affective contexts. However, these studies assume, rather than directly examine, the role of the first sensitive classification element that functions as a prerequisite for the second element (Sheppes, 2024). Specifically, to select regulatory strategies that match the affective context, people first need to sensitively classify the affective context as being high or low in emotional intensity. Therefore, studies need to examine whether sensitive classification of emotional intensity is required in order to flexibly choose between distraction and reappraisal.

To date, existing studies examining the first regulatory selection flexibility element, particularly focusing on sensitive classification of emotional intensity of varying affective contexts, remain sparse and indirect (e.g. Chen & Bonanno, 2021). Specifically, studies found that sensitive classification (including of threat intensity) of varying affective hypothetical scenarios, was associated with reduced depressive and anxious symptomatology (e.g. Bonanno et al., 2020). While clearly important, these studies rooted in an individual difference perspective, provide correlational evidence for associations between the first sensitive classification element and mental health outcomes (i.e. depression and anxiety), rather than providing causal evidence for the impact of the first element on the second element, which together constitute Regultory Selction Flexibilty.

To fill these gaps, this study was set to directly test the correlational (i.e. non-causal association) and causal relationship between the two elements that constitute Regultory Selection Flexibilty. Our study investigated the role of emotional intensity classification that is sensitive to varying emotional stimuli, on a separate behavioural flexible selection measure.

In the present study, sensitive emotional intensity classification was defined as a correspondence between participants' (high or low) intensity categorisation of emotional word stimuli and between the normative emotional intensity category (i.e. high or low intensity that is based on the average intensity level obtained by a large number of participants in the well-established Affective Norms for English

Words, ANEW, Bradley & Lang, 1999). The original normative low and high intensity word stimuli used in the present study were further normed for Hebrew (Effective Norms for Hebrew Words database, Armony-Sivan et al., 2014), and were found to elicit corresponding emotional responses in two independent samples (Fine et al., 2023).

Relying on normative emotional intensity as a criterion for sensitive emotional intensity classification has solid conceptual and empirical grounds. Conceptually, normative emotional intensity categorisation is a type of emotion norm reflecting a relative intersubjective consensus regarding the degree of emotion experienced in one's society (Vishkin et al., 2023). Therefore, classifying an affective context in accordance with the norm reflects sensitivity to ones' social and cultural context. Importantly, in line with the central premise that sensitive classification is adaptive, it has been found that higher adherence to emotion norms is associated with enhanced well-being and reduced psychopathology (Bonanno et al., 2020; Vishkin et al., 2023). Empirically, relying on normative emotional intensity categorisation as a criterion is shared with several central affective measures that define emotional abilities as making responses that match grouped norms, including measures of context sensitivity (Bonanno et al., 2020), emotional intelligence (Mayer et al., 2003), and our measure of flexible selection (i.e. the second element of Regulatory Selection Flexibility, Sheppes, 2024 for review).

The present study included two sections. To provide *correlational* (non-causal association) evidence for the link between the two elements of regulatory selection flexibility, in the first section of the experiment participants performed a slightly modified version of a well-established regulatory selection flexibility paradigm (Matthews et al., 2021; Sheppes et al., 2011 for a meta-analysis), involving the presentation of emotional words of low or high intensity followed by behaviourally choosing between distraction and reappraisal (c.f., Fine et al., 2023). In our modified version, immediately after the presentation of the emotional word (and prior to behaviourally selecting between strategies) participants had to classify the emotional word to high or low intensity categories based on how they think most people would respond. This design feature enabled us to examine the degree to which participants can classify an affective context in accordance with the norm, an ability that reflects sensitivity to ones' social and cultural context and that has proven adaptive (Bonanno et al., 2020; Vishkin et al., 2023). This allowed examining our first hypothesis that on average emotion intensity classification that is sensitive to normative emotion intensity (relative to insensitive classification, and relative to chance) is associated with higher subsequent flexible behavioural selection between distraction and reappraisal. Importantly, this comparison was made between groups of trials (sensitive vs. insensitive classification), rather than between individuals.

To provide *causal* evidence for the influence of the first element on the second element of regulatory selection flexibility, in the second section of our experiment information about sensitive emotion intensity classification was experimentally manipulated. Specifically, participants were randomly assigned to an experimental or control group. Both groups performed another block of the classic regulatory selection flexibility paradigm. However, exclusively in the experimental group, following the presentation of the emotional word and prior to regulatory selection, participants received the normative emotional intensity classification of that word. This manipulation allowed examining our second hypothesis that sensitive emotion intensity classification leads to enhanced flexible selection.

Method

Below we report how we determined the sample size, all data exclusions, all manipulations, and all measures that were collected. The study was approved by the Institutional Review Board of the University. We used standard protocols, exclusion criteria and analytical procedures that have been repeatedly used in our prior studies (e.g. Fine et al., 2023; Shabat et al., 2021).

Participants

Sample size was pre-determined using a formal power analysis (G power, Faul et al., 2009) for the most complex analysis entailing a mixed two-way ANOVA, applying a conventional alpha of .05, 80% power, and an effect size obtained in a prior study with the same paradigm in a similar mixed two-way design (partial $\eta^2 = 0.11$, c.f., Fine et al., 2023). The power analysis indicated that a sample of 68 participants was required to detect a reliable two-way interaction. We decided to oversample by approximately 20% to

account for possible subject exclusion rate that is common in online designs (c.f., Shabat et al., 2021).[1]

The study was administered online (see below various quality checks ensuring high adherence). Inclusion criteria involved Hebrew as a native language (due to the complex verbal instructions c.f., Shabat et al., 2021), no reported history of mental disorders and no current use of psychoactive medications. These inclusion criteria resulted in 86 student participants who completed the online experimental session for monetary compensation (40 NIS). A-priori conservative exclusion criteria that were set in prior emotion regulation studies in our lab (c.f., Shabat et al., 2021), resulted in exclusion of 14 participants (16.3%) prior to analyses. Specifically, one participant was excluded because their completion time (M = 669 minutes) was more than 3 standard deviations of the group mean (M = 55.58 minutes, SD = 6.52 minutes). 13 participants were excluded due to performing 50% or more objective errors (see details below) in describing how they implemented their regulatory strategies (n = 9) or in responding to general attention checks (n = 4). Accordingly, the final sample included 72 participants (M_{age} = 25.64 years, 13 males).

Procedure

The study was created using Gorilla Experiment Builder software (gorilla.sc), and was distributed among designated student Facebook groups. Participants completed the experiment in one online session. To enhance participant engagement, all experimental instructions were administered via pre-recorded video clips, in which participants saw short written experimental instructions accompanied with detailed auditory explanations.

Initially, as part of standard lab procedures (c.f., Shabat et al., 2021) participants filled out a brief demographic questionnaire and answered three background stress, anxiety, and depression questions (on a 1–9 scale) to confirm that the participant population consisted of healthy individuals.[2] Following, participants learned how to implement distraction and reappraisal (two examples for each strategy, order of learning was randomised across participants. c.f., Fine et al., 2023; Shabat et al., 2021). Distraction instructions involved disengaging attention from the negative content of the words by producing unrelated neutral thoughts (e.g. thinking about daily activities, familiar places, or geometric shapes). Reappraisal instructions involved engaging attention with the negative contents of the words, but reinterpreting their meaning (e.g. assuming that the situation described in the word would improve or thinking about less negative aspects of the word). During reappraisal, participants were not allowed to form reality challenge reappraisals (i.e. interpret the negative meaning of the words as fabricated or unreal), since such reappraisal function as a form of disengagement (Sheppes, 2024 for reviews). Following the learning phase, participants practiced choosing between the strategies (two trials).

To evoke genuine affective responses to emotional words that were subsequently regulated, we adopted the previously validated procedures (Itkes & Kron, 2019 for review) where participants were thoroughly instructed to experience each emotional word as representing personally relevant, real-life situations and to refrain from using their semantic knowledge. These procedures were previously proven to maximise the correspondence between self-reports and physiological responses to emotional stimuli (Itkes et al., 2017).

After the general learning and practice phases, participants completed the two sections of the main study. The first section examined the correlational (non-causal) association between sensitive emotion intensity classification and flexible selection between strategies. To that end, participants completed a modified version of the well-established regulatory selection flexibility paradigm (e.g. Fine et al., 2023; Sheppes, 2024 for reviews). Each of the 40 trials began with a brief fixation cross (250 ms) followed by a presentation of a high or low intensity negative word (taken from two pseudo-randomised word orders, with no more than two consecutive trials of the same emotional intensity). Following that, participants answered three questions that were presented below the emotional word in one of two predetermined orders. The main question was "what is the intensity of the emotional word? (high/low)" (until response). However, to disguise the central emotional intensity question participants answered two extra filler questions that were not analyzed: "what is the length of the word? (short/long)" and "what does the word describe? (internal feeling/external event)" (both until response). To adhere to our normative emotion intensity criterion, for all questions, participants were instructed to select an answer based on how they think most people would respond. Following participants' responses, the same high or low

negative intensity word was presented again (2000ms). Then, a choice screen was presented (until response), with the two regulatory options, distraction and reappraisal (the side of each strategy was randomly assigned across participants). Participants were instructed to choose the strategy which they assumed would be more effective in reducing negative emotional experience in response to the word. Importantly, they were not given any information regarding links between emotion intensity and regulatory selection and they were never instructed to select reappraisal for low intensity stimuli and distraction for high intensity stimuli (Sheppes, 2024 for review). Following regulatory selection, the chosen strategy was presented so that participants could prepare to implement it (2000ms). Then the same negative emotional word was presented again (5000 ms), during which participants implemented their chosen strategy.

Although prior studies have widely established that participants implement the strategies they choose (Sheppes, 2024 for review), we also verified behavioural regulatory choice adherence. Specifically, at the end of ten random trials, participants had to write a sentence describing how they implemented the strategy they chose in that trial. A judge who was blind to participants' chosen strategies coded the sentences as distraction or reappraisal. As expected, levels of behavioural adherence approached a perfect score (M = 98.26%, SE = 0.51).

Based on prior studies (Fine et al., 2023; Levy-Gigi et al., 2016; Specker et al., 2023), the dependent variable of flexible selection score was calculated as a linear transformation of the classic regulatory selection flexibility score (i.e. average percentage of regulatory selections; distraction for high intensity normative words and reappraisal for low intensity normative words)[3], and the two-level (sensitive, insensitive) sensitivity independent variable included the group of trials in which participants' intensity classification was sensitive or insensitive to the normative emotional intensity level of the stimulus (i.e. average trials in which normed high and low intensity stimuli were rated as high or low intensity by participants or not).

The goal of the second section of the study was to examine the causal role of sensitive emotion intensity classification on flexible selection between strategies. To that end, before beginning the second part, participants were randomly assigned to one of two conditions: experimental or control groups. Both groups performed another block of the classic regulatory selection flexibility paradigm (with different word stimuli from the first part) but for the experimental group only, following the presentation of the emotional word and prior to regulatory selection, participants received the normative intensity classification of the word (low/high intensity, 3000 ms, and in this part participants did not answer any questions). Following that, all participants were instructed (similar to the first part) to select the strategy they thought would be most effective in reducing their negative emotional experience. No additional guidance or instructions were provided regarding the process of choosing between the strategies. Importantly, this manipulation allowed examining whether providing the normative intensity classification results in enhanced flexible selection. At the end, all participants filled out again the three background questions on stress, anxiety, and depression.

Stimuli

Extensive research has widely established that word stimuli are considered valid affective inducers (c.f., the validation of the ANEW word system Bradley & Lang, 1999 which was developed by the same group that developed the IAPS pictorial system) and that they effectively elicit genuine emotional responses across multiple units of analysis including behavioural (e.g. eliciting approach/avoid responses: Mohammad & Turney, 2010; Weis & Herbert, 2017) and neural domains (i.e. elicit enhanced late positive potential amplitude in EEG studies, and heighted amygdala response in fMRI studies: Hamann, 2001; Herbert et al., 2006; Kensinger & Schacter, 2006; Wager et al., 2003).

In the present study, 80 negative emotional words in Hebrew were selected from an Effective Norms for Hebrew Words database (Armony-Sivan et al., 2014; Fine et al., 2023). The 80 words were randomly divided into two sets, corresponding to the two parts of the study. Specifically, each set included 20 normative high intensity words (first set: Marousal = 6.7; SD = 0.55, Mvalence = 1.95; SD = 0.37; second set: Marousal = 6.7; SD = 0.47, Mvalence = 2; SD = 0.38) and 20 normative low intensity words (first set: Marousal = 4.49; SD = 0.62, Mvalence = 2.9; SD = 0.3; second set: Marousal = 4.6; SD = 0.41, Mvalence = 2.97; SD = 0.38). Across both sets of low negative intensity words, average arousal differed significantly from high negative intensity words (all t's > 11.616

and p's < .001). Emotional words included diverse negative content (e.g. "poverty", "boredom" / "death", "rape", low/high intensity respectively) and were matched across the two intensity categories. Previous studies with similar arousal differences between low and high intensity stimuli have demonstrated differential levels of emotional-response activation (e.g. Bradley et al., 2001(, and differential behavioural regulatory selection (e.g. Sheppes et al., 2011). Importantly, the specific word stimuli we used were further validated in our prior study (Fine et al., 2023) using the same validated standard instruction procedure. This prior study confirmed that reported levels of negative affect for high and low intensity words were congruent with the normative intensity ratings obtained in a prior validation study (Armony-Sivan et al., 2014). Moreover, our previous study using similar word stimuli demonstrated differential levels of emotional-response activation, and differential behavioural regulatory selections (c.f., Fine et al., 2023). Last, as we report in the results below, the fact that we replicated in the present study the pattern of selecting distraction over reappraisal as intensity of emotional words increased from low to high, suggests that participants have experienced necessary levels of differing emotional intensity responses to words, that led them to regulatory decisions obtained in prior studies using images (c.f., Sheppes, 2020 for a review).

Results

Prior to conducting the main analyses, we replicated the well-established regulatory selection finding (Sheppes, 2024 for review) in showing that in the first section that did not include any experimental manipulation, participants' selection of distraction over reappraisal increased as intensity increased from low to high intensity $t(71) = 9.225$, $p < .001$, d = 0.59.

Section I: Correlational (non-causal) association between sensitive emotional intensity classification and flexible regulatory selection

On average participants classified according to the normative emotional intensity of affective words on 77.18% of trials (SD = 8.74%). Clearly supporting the first hypothesis demonstrating the correlational (non-causal) association between sensitive intensity classification and flexible regulatory selection, we found across subjects that on trials in which intensity classification was sensitive to the normative emotion intensity, subsequent flexible regulatory selection (M = 64.48%, SD = 13.53%) was significantly higher relative to a 50% chance level (given that there are two choice options), $t(71) = 9.094$, $p < .001$, d = 1.072, and relative to trials in which the intensity classification was insensitive to the normative emotion intensity (M = 48%, SD = 21.97%), $t(71) = 4.93$, $p < .001$, d = 0.581[4] (see Figure 1).

Section II: The causal role of sensitive emotional intensity classification on flexible regulatory selection

Clearly supporting the second hypothesis of the causal role of sensitive emotional intensity classification on flexible regulatory selection, a mixed two-way ANOVA found a significant two-way interaction involving between subject Group factor (control no intensity classification information, experimental intensity classification information) and a within subject Time factor (pre-manipulation[5], post-manipulation), $F(1,70) = 6.212$, $p = .015$, $\eta^2_p = 0.082$ (See Figure 2). Planned follow-up analyses revealed that, exclusively in the experimental group, providing sensitive stimulus intensity classification led to a significant increase in post-manipulation behavioural flexible regulatory selection scores ($M = 67.36\%$, SD = 1.41) relative to pre-manipulation flexibility scores ($M = 60.83\%$, SD = 2.35), $t(70) = -3.126$, $p = .003$, d = 0.56. Complimentary to this analysis and as expected, in the control group, no significant difference was found in post-manipulation flexibility regulatory selection scores ($M = 62.15\%$,, SD = 1.94) relative to pre-manipulation flexibility scores[6] ($M = 61.32\%$, SD = 1.95), $t(70) = 0.399$, $p = .691$.

Discussion

Conceptual accounts define regulatory selection flexibility as a fundamental ingredient of adaptive functioning that is composed of two sequential elements: (a) classification of affective contexts that is sensitive to their varying nature, followed by (b) flexible selection of regulatory strategies that matches varying affective contexts (Matthews et al., 2021 for a meta-analysis; Sheppes, 2024 for reviews). Despite the widespread agreement of the centrality of regulatory selection flexibility construct, existing empirical evidence focuses on the second element,

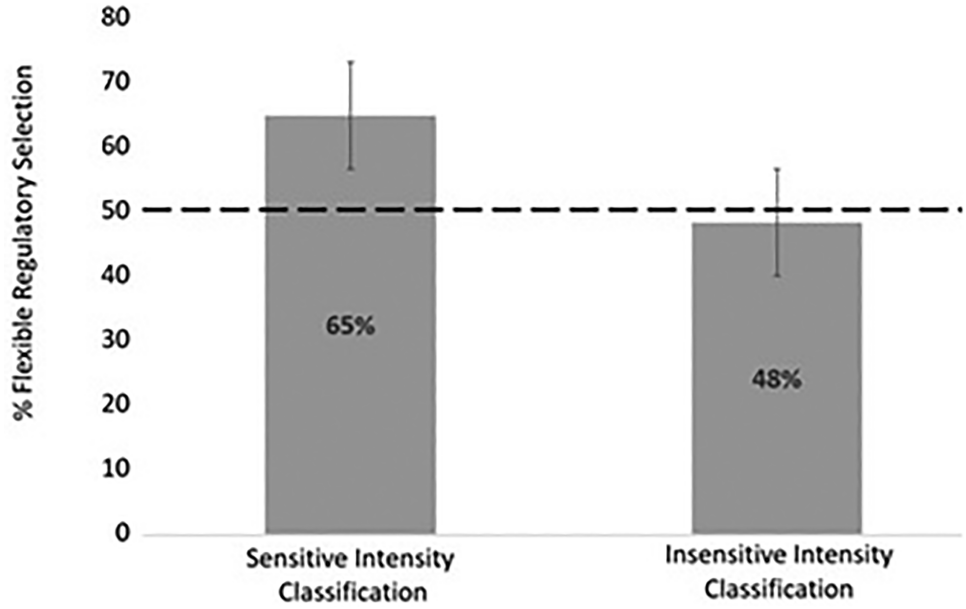

Figure 1. Percentage of flexible regulatory selection (y-axis) on trials that classification was sensitive to normative emotional intesity, and on trials that classification was insensitive to normative emotional intesity (x-axis). Error bars represent standard errors. Note that the horizontal dashed line, indicates a 50% chance level of flexible regulatory selection.

leaving evidence for the first element and for the relationship between the two elements sparse and indirect. Accordingly, the present study provided converging correlational and causal evidence for the role of sensitive classification of a central *emotional intensity* contextual affective variable on a separate behavioural flexible regulatory strategy selection outcome. In particular, the study confirmed the first correlational (non-causal) hypothesis in showing that across subjects, in trials involving intensity classification which were sensitive to the normative emotion intensity of the stimulus (relative to insensitive classification or relative to chance), subsequent higher flexible selection between distraction and reappraisal was demonstrated. Confirming the causal hypothesis, experimentally providing information on sensitive emotional intensity classification to one group (vs. no-information group), led to increased flexible selection from before to after the manipulation.

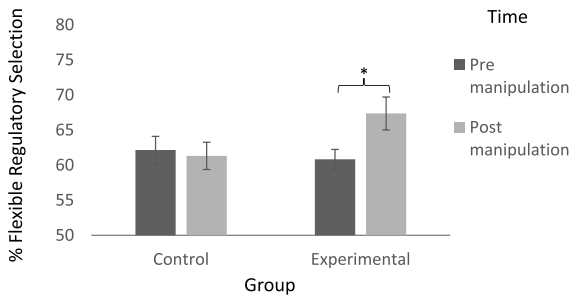

Figure 2. Percentage of flexible regulatory selection (y-axis) among control and experimental groups (x-axis) during pre-manipulation (dark columns) and post-manipulation (light columns). Error bars represent standard errors. *$p < 0.05$.

Our correlational (non-causal) findings add to a central emotional granularity framework, which explains the importance of the ability to distinguish among basic emotional features (e.g. valence and intensity) for adaptive coping (Barrett, 2004). Prior experience sampling studies (e.g. Kalokerinos et al., 2019) exclusively used self-report measures and showed inconsistent results between negative emotional granularity and general strategy usage (an indirect measure of regulatory selection). The present study adds important empirical support for the granularity framework, demonstrating the significance of the ability to classify emotional intensity in a sensitive manner for flexible behavioural selection of matching regulatory strategies. Transcending the correlational findings, the present study also provided causal evidence for the influence of sensitive emotional intensity classification on flexible regulatory selection. Specifically, we showed that providing sensitive emotional

intensity classification led to increased behavioural flexible regulatory selection. The importance of this finding is in demonstrating that temporarily enhancing one's ability to classify the intensity of affective events in a sensitive manner, results in being able to select between regulatory strategies in a flexible and thus adaptive manner.

Taken together, our correlational and causal findings provide the first direct empirical evidence for the building blocks of regulatory selection flexibility construct (Sheppes, 2024). Transcending prior work, we provide the first demonstration for a two-element construct in showing that sensitive classification of a central *emotional intensity* contextual affective variable (the first element) is associated with and leads to flexible matched regulatory selection between strategies (the second element).

Theoretically, the two elements that constitute Emotion Regulation Flexibility relate to several canonical theoretical stage models. Specifically, our first element is congruent with the Identification stage in Gross's extended process model (Gross, 2015) and with the Context Sensitivity element in Bonanno's regulatory flexibility sequence (Bonanno et al., 2024). Our second element is congruent with the Selection stage in Gross's extended process model (Gross, 2015) and with the Repertoire element in Bonanno's regulatory flexibility sequence (Bonanno et al., 2024).

Beyond the theoretical contribution, the present study holds important clinical implications. Regarding clinical assessment, central transdiagnostic frameworks (Sheppes et al., 2015 for review) link different impairments in sensitive classification processes with distinct psychopathologies. For example, it has been suggested that failures in the perception process of the identification stage (i.e. over or underrepresentation of emotional events) may underly regulatory problems in various disorders. For example, over-representing mild emotional events may potentially lead to increased regulatory efforts that are unnecessary and maladaptive in panic disorder (McNally, 2002; Olatunji et al., 2007; Schmidt et al., 1998). Relatedly, prior clinical research found that reduced sensitive classification of threat intensity was associated with reduced depressive and anxious symptoms (Chen & Bonanno, 2021). Our findings showing that reduced sensitive intensity classification leads to reduced flexible selection (an important predictor of mental health), suggest that future research should examine whether the association between sensitive classification and psychopathology can be explained by reduced flexible selection.

Somewhat speculatively, our causal findings raise the potential of designing future clinical training interventions that target the improvement of sensitive emotional intensity classification, which may result in important downstream effects involving improvements in flexible selection and adaptive functioning. Specifically, novel evidence from our lab shows that an intervention aimed at improving sensitive classification (relative to a tight control condition) led to enhanced flexible selection and higher well-being (Fine et al., under review).

Several limitations and future directions should be noted. First, although the present study focused on a central emotional intensity factor, there are additional contextual factors that are predicted to affect regulatory selection flexibility (Bonanno et al., 2020). One essential contextual factor entails the controllability of affective events (Bonanno et al., 2020; Kalokerinos & Koval, 2024). Hence, follow-up studies should examine whether sensitive classification of changes in the controllability of affective situations, are associated with higher regulatory selection flexibility.

Second, although our design includes only two strategies, it may have important clinical implications nonetheless, given recent research demonstrating that even teaching a single regulatory strategy (i,e., cognitive reappraisal, see review Riepenhausen et al., 2022) yields significant real-life mental health benefits. Nevertheless, future studies should understand whether the ability to sensitively classify the emotional intensity is relevant to a wider strategy repertoire.

Third, our use of objective normative intensity classification measure is shared with several other central affective measures that characterise emotional abilities as making responses that match grouped norms (e.g. Bonanno et al., 2020; Mayer et al., 2003). Nevertheless, future studies should use other measures of emotional intensity classification (e.g. objective physiological measures, c.f., Ardi et al., 2021, or subjective self-reports), and examine whether sensitive classification that is based on these measures is associated with flexible regulatory selection. Relatedly, since emotional norms vary across cultures (Vishkin et al., 2023) future research

should take into account cultural influences and be cautious when trying to generalise research findings across societies.

Fourth, the current findings were obtained using simple emotional word stimuli and future studies should examine the translational value of our findings in real-life emotional events that are much more complex. It bears noting that in other close fields, training of a certain ability (e.g. attention allocation) using simple emotional stimuli (including emotional words) resulted in real life change (e.g. reduced symptomatology, Badura-Brack et al., 2015). Additionally, the use of affective words (relative to images) might limit the extent of elicited affective responses, thus future research should replicate these findings with other evocative stimuli.

Fifth, in section two of the study our empty control condition refrained from including random classification information, due to concerns that it could introduce confusion and impair participants' task performance. Although future studies should consider other control conditions, it bears noting that the fact that the present study provides converging correlational evidence to our causal experimental evidence, strengthens our confidence in the role of sensitive classification of intensity on flexible selection.

Sixth, future studies should be designed in a manner that can entirely rule out the possibility that our section 1 had carryover of intensity rating effects on section 2. Nevertheless, our study procedure and actual findings significantly limit the degree of this concern. Specifically, in an effort to minimise the likelihood of Section 1 carryover of intensity rating effects, the design of Section 1 involved having participants answer two filler questions in addition to the main intensity question. Importantly, if practicing during Section 1 per-se leads to improvement in flexible selection in Section 2, we would expect to see such improvement in the control group. However, actual findings in the control group showed no improvement in flexible selection. Relatedly, our significant interaction analysis showing higher flexible selection in the experimental relative to the control group, exclusively in Section 2 (following similar practice in both groups in Section 1) further strengthens our interpretation of an influence of the intervention.

Lastly, the present research demonstrated correlational and causal group findings in a healthy population. In light of prior studies demonstrating reduced flexible selection among trauma related pathologies (Fine et al., 2023; Levy-Gigi et al., 2016), follow-up studies should examine in clinical populations whether impaired flexibility is partially due to impaired intensity classification. Studies in both healthy and psychopathological populations with larger samples should also investigate individual differences in sensitive classification and their relationship to flexible selection.

Notes

1. See also below that the actual 16.3% exclusion rate matched our expectation.
2. Confirming that our participant population consisted of healthy individuals, the observed mean and variance levels of the 3 background questions (stress, anxiety, and depression) were minimal ($M_{range} = 2.2–2.7$, $SD_{range} = 1.3–1.6$ on a 1–9 scale).
3. The measure we used is a linear transformation that is mathematically equivalent to the classic regulatory selection flexibility score (c.f., Levy-Gigi et al., 2016) that involves subtracting the proportion of distraction selection in the low normative intensity condition (which reflects maladaptive behavior) from the proportion of distraction selection in the high normative intensity condition (which reflects adaptive behavior). Our measure of regulatory selection flexibility was used because it is appropriate for grouped trial analysis that includes non-similar trial numbers for sensitive and non-sensitive categorization of high and low intensity stimuli for different participants.
4. It bears noting, that in insensitive intensity classification trials the percentage of regulatory selection flexibility ($M = 48\%$, $SD = 0.22$) was not significantly different from the 50% chance level, $t(71) = -0.772$, $p = .442$.
5. To verify that random assignment was successful, we showed that the two groups (experimental and control) did not differ in any of the pre-manipulation variables including demographic characteristics and emotional questions (all t's smaller than 1.163, $\chi 2 < 0.205$, and all p's > 0.11), as well as in sensitive emotional intensity classification (experimental group; $M = 79.17\%$, $SD = 8.84\%$, control group; $M = 76.04\%$, $SD = 7.54\%$, $t(70) = -1.613$, $p = .111$) and in flexible regulatory selection (experimental group; $M = 60.83\%$, $SD = 1.41$, control group; $M = 62.15\%$, $SD = 1.95$, $t(70) = 0.549$, $p = .585$) during the pre-manipulation first section assessment.
6. It bears noting that the post-manipulation flexibility score of the experimental group was significantly higher than all three other conditions ($t(138.534) = 2.851$, $p = .005$), and the three other conditions did not differ from each other (all t's < 0.48, all p's > 0.632). This result indicates that the experimental manipulation had a unique effect on post-manipulation flexibility scores in the experimental condition.

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