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Regulatory focus moderates the relationship between task control and physiological and psychological markers of stress: A work simulation study

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ABSTRACT

This experiment examined whether trait regulatory focus moderates the effects of task control on stress reactions during a demanding work simulation. Regulatory focus describes two ways in which individuals self-regulate toward desired goals: promotion and prevention. As highly promotion-focused individuals are oriented toward growth and challenge, it was expected that they would show better adaptation to demanding work under high task control. In contrast, as highly prevention-focused individuals are oriented toward safety and responsibility they were expected to show better adaptation under low task control. Participants ($N = 110$) completed a measure of trait regulatory focus and then three trials of a demanding inbox activity under either low, neutral, or high task control. Heart rate variability (HRV), affective reactions (anxiety & task dissatisfaction), and task performance were measured at each trial. As predicted, highly promotion-focused individuals found high (compared to neutral) task control stress-buffering for performance. Moreover, highly prevention-focused individuals found high (compared to low) task control stress-exacerbating for dissatisfaction. In addition, highly prevention-focused individuals found low task control stress-buffering for dissatisfaction, performance, and HRV. However, these effects of low task control for highly prevention-focused individuals depended on their promotion focus.

1. Introduction

World Health Organization (2013) statistics reveal cardiovascular diseases (CVDs) are responsible for most deaths due to disease. Clearly, further research identifying risk factors for onset of CVDs, and interventions to reduce this risk, is needed. One such CVD risk factor is occupational stress (Kivimaki et al., 2006). Occupational stress is a process whereby employees experience high demands (e.g., workload) that exceed their resources to cope. Experiments demonstrate how increased task demands directly affect cardiovascular reactivity in the short-term (e.g., Flynn and James, 2009). Epidemiological studies also identify work demands as a risk factor for metabolic syndrome, a pre-condition for cardiovascular mortality (Backe et al., 2012; Ganster and Rosen, 2013). As well as these health consequences, occupational stress impairs well-being (e.g., anxiety, depression, and burnout; see Crawford et al., 2010; Häusser et al., 2010) and performance (Gilboa et al., 2008; Ortqvist and Wincent, 2006). To better inform stress management interventions and work redesign strategies, further research is needed to identify the proximal physiological and psychological processes involved in the unfolding experience of occupational stress.

Theoretical models of occupational stress (i.e., Job Demands–Control Model; JD–CM, Karasek, 1979; Job Demands–Resources Model; JD–RM, Bakker and Demerouti, 2007) include work control as a job resource that protects employees from the detrimental effects of work demands. Work control refers to control available in the work environment and employee discretion over methods and pacing of work. Research has focused on the chronic effects of high demands and low work control on physiological health (particularly CVDs) and psychological health (e.g., Chandola et al., 2006; Peter and Siegrist, 2000), with meta-analytical research on the JD–CM showing modest support for these relationships (de Lange et al., 2003; Häusser et al., 2010; van der Doef and Maes, 1998; 1999). Limited research has examined whether providing high task control facilitates better adaptation *in the moment*.

Work control might not reduce stress reactions for all employees in the same way (as proposed by van der Doef and Maes, 1999). Indeed, research has revealed that traits such as locus of control (Meier et al., 2008) and desire for control (Parker et al., 2009) moderate the stress-buffering effects of work control. Moreover, workplace interventions that increase employee control only improve mental health and performance for those high on certain traits (e.g., psychological flexibility; Bond et al., 2008, 2009). As such, we examined trait regulatory focus as a moderator of task control, using an experiment where levels of task control were manipulated during a demanding work task.

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1.1. Facilitating regulatory fit by modifying work structure

Regulatory focus is a motivational process whereby individuals self-regulate behavior to achieve desired goals via *promotion* or *prevention* forms (Higgins, 1997). Experimental studies have demonstrated that highly promotion-focused individuals use approach-oriented strategies (i.e., maximizing correct hits, gaining rewards), as they are concerned with growth and opportunities that place them closer to reaching their *ideal self*. Highly prevention-focused individuals use avoidance-oriented strategies (i.e., minimizing incorrect responses, avoiding punishment), as they are concerned with safety and responsibilities that place them closer to reaching their *ought self* (Higgins, 1997; Higgins et al., 1998).

Regulatory focus has been studied as a chronic trait or induced state (e.g., through priming; Crowe and Higgins, 1997; Higgins et al., 1994). Ostensibly, trait regulatory focus could be central to determining if control is stress-buffering, as it is a motivational construct central to the process of self-regulation. Indeed, regulatory focus is the proximal mechanism through which more distal personality traits (e.g., extraversion and conscientiousness) influence work outcomes (Lanaj et al., 2012; Gorman et al., 2012). Indeed, research has shown that trait regulatory focus is a stronger predictor than state-induced regulatory focus on task performance (i.e., anagram tasks; Higgins et al., 1998). Moreover, inducing state regulatory focus in opposition to trait regulatory focus during a task (creating a goal "mismatch") can increase systolic blood pressure (Peddie et al., 2012), illustrating the importance of matching trait regulatory focus to work structures (Brockner and Higgins, 2001).

We examine this regulatory "mismatch", but also aim to identify whether facilitating regulatory-fit during a demanding task can help with adaptation. The concept of 'regulatory fit' at work (Brockner and Higgins, 2001) offers insight into why matching work systems to trait regulatory focus may reduce stress and facilitate coping. For example, regulatory fit should occur when incentive systems are aligned (e.g., reward systems for promotion versus avoidance systems for prevention). Indeed, enhancing regulatory fit can increase performance; based on findings that anagram task performance was highest when trait regulatory focus matched congruent incentives (Shah et al., 1998). While many theories posit that work demands and resources are central to occupational stress, traits (or personal resources) can also be viewed as important in determining the utility of work resources as stress buffers (Demerouti and Bakker, 2011). We propose that regulatory focus should be taken into account when considering work control as a resource for stress reduction, as work control is expected to differentially suit these two types of self-regulatory tendency.

The presence of high work control is theorized to facilitate learning and growth (Karasek, 1979). As highly promotion-focused individuals are oriented toward growth (see Lanaj et al., 2012), the presence of high work control is expected to facilitate regulatory-fit for these individuals. High work control may be stress-buffering for highly promotion-focused individuals, as they feel work demands can be met in a way that provides positive learning and growth experiences. Alternatively, highly promotion-focused individuals are expected to find low work control stress-exacerbating, as it limits personal choice and growth.

From another perspective, high work control can place greater responsibility on individuals for making decisions about methods and procedures. This increased responsibility may induce stress for individuals who view high control as threatening, as increasing the need to formulate one's own strategies increases the chance of personal error (Burger, 1989; Shapiro et al., 1996). As highly prevention-focused individuals are oriented toward safety, it is expected that high work control will be stress-exacerbating for these individuals. Concern about making personal errors could inhibit the learning and growth that high work control may otherwise afford. Low work control is expected to provide the structure and safety that highly prevention-focused individuals prefer, facilitating stress-buffering effects. Indeed, prior research demonstrates that low work control is stress-buffering for individuals' who are non-self-determined (Parker et al., 2013a) or lower on desire for control (Parker et al., 2009).

1.2. The current study

1.2.1. Our approach

Many occupational stress researchers focus on collecting correlational data in work contexts to infer associations between demand, control, and employee health (de Lange et al., 2003). Other researchers utilize experimental paradigms, which involve participants completing work simulations under manipulated levels of demand and control (e.g., Flynn and James, 2009; Häusser et al., 2011; Jimmieson and Terry, 1997, 1999; Parker et al., 2009, 2013a, 2013b). Work simulations establish temporal precedence between predictors and outcomes, offering strong causal interpretation. Laboratory settings also increase control over collection of physiological data, an additional strength.

Experiments on the effects of task control on physiological measures reveal mixed effects; for example, finding no stress-buffering effects on systolic blood pressure (Flynn and James, 2009; Hutt and Weidner, 1993), heart rate (Flynn and James, 2009; Hutt and Weidner, 1993; Perrewe and Ganster, 1989), galvanic skin conductance, or skin temperature (Flynn and James, 2009; Perrewe and Ganster, 1989). The exception was Häusser et al. (2011) who found that high control produced stress-buffering effects for cortisol. These inconsistent effects could be due to choice of (1) physiological measure, (2) task (i.e., mental subtraction vs. work simulation), and (3) little consideration of individual differences. We address many of these inconsistencies by measuring Heart Rate Variability (HRV), using a demanding work simulation, and investigating regulatory focus as a moderator of task control. Although Flynn and James (2009) found that high task demands increased heart rate and systolic blood pressure, and Häusser et al. (2011) found that high task demands increased cortisol under low task control, no task control study has examined emotion regulation as reflected in HRV.

HRV reflects variability in the beat-to-beat changes in heart rate pattern (Berntson et al., 1997). HRV is measured non-invasively by electrocardiogram (ECG) and scores can be derived from spectral power analyses (Montano et al., 2009). Research has found HRV to be a sensitive index of mental workload (i.e., physiological coping efforts; Hoover et al., 2012; Jorna, 1992). Indeed, experimental and neuroimaging studies support that HRV reflects emotion regulation processes (Appelhans and Luecken, 2006; Geisler et al., 2010; Segerstrom and Nes, 2007; Thayer et al., 2012). HRV has the potential to be a meaningful indicator of functioning in work contexts, where individuals are exposed to stressors that require daily emotion regulation (Diefendorff et al., 2008).

High frequency HRV (HRV-HF) is considered a relatively pure measure of parasympathetic cardiac control (i.e., the down-regulation of the parasympathetic nervous system (PNS) onto the sympathetic nervous system (SNS); Berntson et al., 2008; Thayer et al., 2012). As the SNS increases adrenaline and the "stress response" (increasing blood and oxygen flow to the muscles), down-regulation by the PNS suggests the organism is more successfully regulating stress and arousal. Low frequency HRV (HRV-LF) is linked to SNS activity; however, the literature remains unclear as to whether this represents a general heightened arousal (i.e., both PNS and SNS) or a lack of PNS activity (see Berntson et al., 2008). We included both HRV-HF and HRV-LF as physiological indicators of the stress experience, as this is reflective of individuals' total emotion regulation.

1.2.2. Summary

We examined whether trait regulatory focus moderates the effects of task control on physiological and psychological indicators of stress (i.e., HRV, anxiety, task dissatisfaction, and task performance). We used a work simulation involving three trials of a demanding inbox task. Task control (i.e., low, neutral, and high) was manipulated prior to trial 2 to examine changes in our dependent variables as a result of

Table 1
Descriptive statistics and bivariate correlations ($N = 110$).

	M	SD	1	2	3	4	5	6	7	8	9	10	11
Baseline													
(1) HR (bpm)	83.20	11.85	–										
(2) HRV-HF (ms^2)	738.38	703.25	−.65**	–									
(3) HRV-LF (ms^2)	1044.82	805.71	−.52**	.68**	–								
(4) Anxiety	1.97	0.90	.10	.11	−.01	(.89)							
Measured traits													
(5) Promotion Focus	5.71	0.80	−.10	.08	.12	−.16	(.88)						
(6) Prevention Focus	4.68	0.91	−.00	.07	.10	.10	.13	(.77)					
Trial 1													
(7) HR (bpm)	83.50	10.91	.95**	−.61**	−.45**	.12	−.07	.02	–				
(8) HRV-HF (ms^2)	373.72	493.76	−.55**	.92**	.56**	.11	.06	.06	−.56**	–			
(9) HRV-LF (ms^2)	745.02	580.45	−.51**	.68**	.75**	−.06	.08	.10	−.48**	.70**	–		
(10) Anxiety	2.16	0.92	.06	.06	−.08	.55**	−.17	.10	.08	.02	−.12	(.85)	
(11) Task Dissatisfaction	3.10	1.10	−.02	.01	.05	.05	−.13	.21*	−.01	.04	.05	.16	(.77)
(12) Number of Emails	3.30	1.22	.15	−.12	.02	−.12	.14	−.15	.17	−.10	.02	−.18^{t}	.01
(13) Average Words	60.22	26.84	−.27**	.25**	.19^{t}	−.03	−.03	.03	−.27**	.23*	.20*	−.09	−.07
Trial 2													
(14) HR (bpm)	80.06	10.11	.93**	−.61**	−.46**	.03	−.03	.07	.94**	−.56**	−.48**	.04	−.03
(15) HRV-HF (ms^2)	424.79	504.91	−.53**	.90**	.60**	.12	.06	.05	−.54**	.95**	.62**	.03	.05
(16) HRV-LF (ms^2)	896.11	680.27	−.47**	.60**	.78**	−.01	.08	.11	−.45**	.59**	.85**	−.19*	.04
(17) Anxiety	1.80	0.83	.06	.00	.04	.35**	−.08	.13	.09	.02	.01	.68**	.06
(18) Task Dissatisfaction	3.11	1.18	−.06	.02	.02	.04	−.12	.22*	−.03	.03	.06	.16	.79**
(19) Number of Emails	4.03	0.97	.24*	−.19^{t}	−.03	−.09	−.06	−.14	.24*	−.19*	−.08	−.13	−.05
(20) Average Words	56.21	27.41	−.19*	.24*	.14	−.02	.14	.13	−.18^{t}	.25**	.21*	−.05	.04
Trial 3													
(21) HR (bpm)	78.37	9.80	.92**	−.60**	−.46**	.02	−.04	.06	.93**	−.56**	−.50**	.02	−.02
(22) HRV-HF (ms^2)	488.61	632.60	−.48**	.85**	.53**	.13	.07	.09	−.48**	.91**	.64**	.04	.11
(23) HRV-LF (ms^2)	981.55	870.81	−.50**	.71**	.71**	.04	.01	.11	−.47**	.74**	.91**	−.10	.10
(24) Anxiety	1.64	0.79	.09	.03	−.07	.35**	.05	.21*	.13	.06	−.03	.55**	−.03
(25) Task Dissatisfaction	3.06	1.30	−.06	.01	.02	.04	−.09	.18^{t}	−.02	.01	.07	.07	.72**
(26) Number of Emails	4.39	0.81	.15	−.20*	−.04	−.13	.02	−.07	.18^{t}	−.26**	−.10	−.17^{t}	.04
(27) Average Words	55.54	20.49	−.21*	.28**	.19*	−.03	.07	−.03	−.23*	.29**	.22*	.00	−.11

Notes. bpm = beats per minute; alpha coefficients for reliability appears in parentheses for self-report variables.
^{t} $p = .075$.
* $p < .05$.
** $p < .01$.

the introduction of varying levels of task control, and subsequently, adaptation to this by trial 3.

1.2.3. Hypotheses

Hypothesis 1. a) Higher promotion-focused individuals will experience better adaptation under high (as compared to low or neutral) task control, which will be reflected in lower HRV-LF, anxiety, and task dissatisfaction, as well as higher HRV-HF and task performance, and b) higher promotion-focused individuals will experience poorer adaptation under low (as compared to high or neutral) task control, which will be reflected in higher HRV-LF, anxiety and task dissatisfaction, as well as lower HRV-HF and task performance.

Hypothesis 2. a) Higher prevention-focused individuals will experience better adaptation under low (as compared to high or neutral) task control, which will be reflected in lower HRV-LF, anxiety and task dissatisfaction, as well as higher HRV-HF and task performance, and b) higher prevention-focused individuals will experience poorer adaptation under high (as compared to low or neutral) task control, which will be reflected in higher HRV-LF, anxiety and task dissatisfaction, as well as lower HRV-HF and task performance.

Typically researchers investigate the effects of promotion and prevention focus separately; however, it is plausible that the effects of one foci depends on levels of the other foci. Higgins (1997, 1998) originally proposed the two regulatory foci were independent dimensions rather than opposite ends of a spectrum. A key concern is whether these foci represent isolated strategies (Gorman et al., 2012). Individuals could be high on both foci, low on both, or high on one and low on the other (Förster et al., 2003). Indeed, the process of self-regulation may unfold differently depending on patterns of regulatory foci (Higgins, 1997, 1998; Lanaj et al., 2012), and accessibility of specific patterns of foci may depend on situational or task demands (Brockner and Higgins, 2001). As such, in our analysis we included a higher-order interaction to test if Hypothesis 1 is moderated by prevention focus, and if Hypothesis 2 is moderated by promotion focus.

2. Method

2.1. Participants

Participants were 110 Australian university students. More were female ($n = 68$) than male ($n = 42$), with age ranging 17 to 42 years ($M = 20.56$; $SD = 3.91$). Most (79.10%) had prior work experience. All participants met established health inclusion criteria (i.e., no cardiovascular disease/disorder, heart medications, or use of recreational/stimulant drugs).

2.2. Design and procedure

Trait regulatory focus (and demographic information) was measured one week prior to the experimental session in order to separate the measurement of personality from participants' reactions and behavior during the work simulation. This experiment was a 3 (trials: T1, T2, and T3; within-subjects) × 3 (task control: high, neutral, or low; between-subjects) mixed design. On arrival, participants were connected to a Schiller “Medilog AR12plus” portable ECG monitor (with a sampling rate of 8000 Hz; 1000 Hz actual recording rate when in scientific mode), which recorded an ECG trace for the whole experimental session. Participants were seated at a computer terminal and asked to complete a baseline survey. During this time, a baseline recording of participants' HRV was taken for 6 min. Participants then received

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
–														
$-.39^{**}$	–													
.16	$-.28^{**}$	–												
−.05	$.23^{*}$	$-.57^{**}$	–											
.07	$.18^{t}$	$-.47^{**}$	$.63^{**}$	–										
−.15	.05	.06	−.01	−.07	(.88)									
.03	−.03	.01	.03	.09	.12	(.78)								
$.52^{**}$	$-.31^{**}$	$.22^{*}$	−.13	−.05	$-.17^{t}$	−.04	–							
$-.20^{*}$	$.68^{**}$	−.17	$.21^{*}$	.14	.08	−.00	$-.44^{**}$	–						
.09	$-.23^{*}$	$.98^{**}$	$-.57^{**}$	$-.48^{**}$	.05	−.02	$.19^{t}$	−.14	–					
.03	.17	$-.51^{**}$	$.93^{**}$	$.57^{**}$	.01	.11	−.08	$.18^{t}$	$-.54^{**}$	–				
.06	$.22^{*}$	$-.50^{**}$	$.69^{**}$	$.84^{**}$	.01	.15	−.06	$.22^{*}$	$-.54^{**}$	$.74^{**}$	–			
−.10	−.06	.09	.01	−.08	$.69^{**}$	−.03	−.14	.09	.11	.03	−.01	(.84)		
−.00	.00	.01	−.00	.09	.06	$.90^{**}$	−.04	.00	−.02	.08	.16	−.06	(.81)	
$.48^{**}$	$-.31^{**}$	$.21^{*}$	$-.20^{*}$	−.07	$-.23^{*}$	.09	$.64^{**}$	$-.33^{**}$	$.19^{*}$	−.17	−.15	$-.22^{*}$	.06	–
−.06	$.62^{**}$	$-.26^{**}$	$.28^{**}$	$.20^{*}$	.14	$-.17^{t}$	$-.19^{*}$	$.63^{**}$	$.25^{**}$	$.24^{*}$	$.27^{**}$	.07	$-.17^{t}$	$-.55^{**}$

verbal and audio instructions on the inbox activity that outlined the organizational context and their role. A program was used to create the email inbox for each participant, which randomly selected and ordered emails for each trial. Participants then completed three trials of the inbox activity. Participants were randomly assigned to task control conditions through task instructions given prior to trial 2 (taking 5 min). A reminder intervention re-stating the aims of the task and the task instructions was introduced prior to trial 3 (taking 2 min). After each trial, participants completed a post-task survey assessing anxiety, task dissatisfaction, and the manipulation checks (assessing perceptions of task control and task demands; taking 5 min). At the end of the session, participants were detached from the ECG monitor, thanked, and debriefed.

2.3. Inbox activity

The inbox activity used email content developed for previous work simulation experiments by Parker et al. (2013a) and Parker et al. (2013b). Participants were asked to adopt the role of a HR Manager at a department store, in responding to employee emails. Trials consisted of 5 emails to be completed within 10-min. Previous research has validated this level of workload and time pressure as representative of moderately high task demands (Parker et al., 2013a, 2013b). Task instructions conveyed to participants that their objective was to: (1) provide quality responses that addressed the main concerns of the employees emailing them and (2) attempt to answer all emails in their inbox within the time provided, during each trial.

2.4. Experimental manipulation of task control

Task control was manipulated through instructions provided to participants prior to trial 2. The manipulation was based on prior research on behavioral control over work tasks (Jimmieson and Terry, 1997, 1999; Parker et al., 2009, 2013a, 2013b; Perrewe and Ganster, 1989). In the high task control condition, *email guidelines* emphasized participants could choose their method for responding to emails and their work pace. In the low task control condition, an *email policy* provided strict instructions that emails should be completed in chronological order at a consistent pace. In the neutral task control condition participants were not provided with additional task instructions but played a computer game (i.e., Solitaire or Minesweeper) for 5 min, under the guise the next trial was being loaded.

2.5. Measures

2.5.1. Regulatory focus

We administered the General Regulatory Focus Measure (GRFM; Lockwood et al., 2002) one week before the work simulation. Items were assessed on a scale ranging from 1 (*not at all true of me*) to 7 (*very true of me*). The promotion sub-scale included 9 items (e.g., "*I typically focus on the success I hope to achieve in the future*"). The prevention sub-scale included 9 items (e.g., "*I am more oriented towards preventing losses then I am towards achieving gains*").

2.5.2. ECG

The AR12plus recorders use a 3 channel bipolar ECG amplifier. We positioned the leads on the chest, in order to minimize muscle artifacts and maximize the ECG amplitude. ECG data were filtered and transformed using Medilog Darwin software, which analyses the ECG trace with adherence to accepted guidelines for measurement and interpretation of HRV data (European Task Force, 1996; Berntson et al., 1997). Only the normal beats (via R-peak detection) were used in the HRV analysis (thus excluding artifacts and irregular beats). Missing data was less than 5%. The sampling period was 4000 Hz at a time resolution of 250 μs. Linear detrending was used.

We conducted spectral power analysis to derive frequency data by application of the discrete Fourier transform to the beat-to-beat interval time series. We coded data as being from baseline, during trial 1, 2, and 3 time periods. Means for these periods were created from the samples downloaded from Medilog Darwin (i.e., 3 × 2 minute samples for baseline; 5 × 2 minute samples for each of the three trials). It should be noted that we did not measure or control for respiration. There is a debate in the literature regarding the influence of respiration on HRV; with some evidence suggesting that this has no bearing on HRV-HF (e.g., Porges and Byrne, 1992) and some evidence suggesting that this can influence HRV-LF (e.g., Beda et al., 2014). For interpretation, Heart Rate (HR) scores are displayed in Table 1.

2.5.2.1. HRV-HF. Following recommendations in previous research to achieve a reliable representation of the high frequency spectrum, HRV-HF was calculated by integrating the spectral power across the upper frequency band (0.15–0.40 Hz).

2.5.2.2. HRV-LF. To capture the low frequency spectrum, HRV-LF was calculated by integrating the spectral power across the lower frequency band (0.04–0.15 Hz).

2.5.3. Affective task reactions

2.5.3.1. Anxiety. Items from the Profile of Mood States (McNair et al., 1971) were administered at baseline and after each trial. Anxiety adjectives (i.e., *anxious*, *nervous*, *tense*) captured how participants felt "*right now*", on a scale from 1 (*not at all*) to 5 (*extremely*).

2.5.3.2. Task dissatisfaction. Two items from Jimmieson and Terry's (1997) measure of task satisfaction were administered after each trial. Items included "*To what extent did you enjoy performing the inbox activity*" and "*Knowing what you know now, if you had to decide again, would you participate*". Items were reverse coded to reflect dissatisfaction.

2.5.4. Task performance

2.5.4.1. Number of emails. For each trial, the number of emails responded to was recorded. This was scored out of 5 for each trial.

2.5.4.2. Average words. For each trial, number of words written for each email was summed and then divided by the number of emails completed during that trial.

2.5.5. Manipulation checks

In order to verify task control perceptions changed from one trial to another as a function of the task control manipulations, and to confirm that task demand perceptions (i.e., workload and complexity) did not, manipulation checks were administered after each trial. Each check used 4-items (drawn from previous research; Jimmieson and Terry, 1999; Parker et al., 2009, 2013a, 2013b) assessed on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). An example workload item is "*I had a great deal of workload*" ($\alpha = .74$–$.76$). An example complexity item is "*The inbox activity required a high degree of knowledge, skill, and ability*" ($\alpha = .78$–$.80$). An example task control item is "*How much control did you have over your actions during this activity*" ($\alpha = .82$–$.91$).

3. Results

3.1. Manipulation checks

As expected, ANOVAs on the manipulation checks of task demand perceptions confirmed no main effects of task control on workload, $F(2, 103) = 0.55$, $p = .579$, *ns*, or complexity, $F(2, 103) = 0.05$, $p = .954$, *ns*, or interactions with task control, $F(4, 183) = 1.97$, $p = .109$, $F(4, 184) = 0.40$, $p = .784$, *ns*, respectively. Across the three trials of the inbox activity, means for task demands were above the midpoint of the scale; workload $Ms = 4.69$–4.79, $SDs = 1.06$–1.10; complexity $Ms = 4.58$–4.81, $SDs = 1.13$–1.34, confirming that the work simulation was perceived as moderately demanding by participants.

An ANOVA revealed task control perceptions varied as a function of the task control manipulation. There was no significant main effect of condition, $F(2, 103) = 0.52$, $p = .597$, *ns*, however, there was a significant 2-way interaction of trials by condition, $F(4, 199) = 4.00$, $p = .004$, partial $\eta^2 = .072$. Pairwise comparisons revealed in the high task control condition, task control perceptions significantly increased from trial 1 ($M = 4.77$, $SE = 0.17$) to trial 2 ($M = 5.21$, $SE = 0.18$; $p = .004$), and from trial 1 to trial 3 ($M = 5.10$, $SE = 0.19$; $p = .027$). Although task control perceptions at trial 3 remained elevated, these were not significantly increased from trial 2. In the low task control condition, task control perceptions significantly decreased from trial 1 ($M = 4.89$, $SE = 0.18$) to trial 2 ($M = 4.57$, $SE = 0.18$; $p = .035$). Participants' task control perceptions then increased from trial 2 to trial 3 ($M = 5.04$, $SE = 0.19$; $p < .001$). A marginally significant comparison for the neutral task control condition suggested that task control perceptions increased from trial 2 ($M = 5.08$, $SE = 0.19$) to trial 3 ($M = 5.18$, $SE = 0.19$; $p = .069$). Overall, task control perceptions varied as a function of the manipulations at the time these manipulations were introduced (i.e., prior to trial 2), however, as participants gained more experience on the task from trial 2 to trial 3, they regained some perception of control in the neutral and low task control conditions, whereas participants in the high task control condition had an initial increase in control perceptions from trial 1 to trial 2, which was maintained at trial 3.

3.2. Data analysis strategy

As displayed in Table 1, the correlation between promotion and prevention was non-significant ($r = .13$, *ns*), supporting the treatment of these variables as orthogonal constructs. In order to test our hypotheses, Hierarchical Moderated Regression (HMR) analyses were performed on change scores (i.e., change from Trial 1 to Trial 2, by subtracting scores at Trial 2 from scores at Trial 1; change from Trial 2 to Trial 3, by subtracting scores at Trial 3 from scores at Trial 2) for each dependent variable (see Edwards, 2001; West et al., 1996). These change scores were computed so that positive values reflected an increase in the dependent variable whereas negative values reflected a decrease.

At Step 1, relevant baseline variables were entered (i.e., anxiety and HRV). A baseline measure is recommended when problems with skewed physiological data may arise (see Jamieson, 1999). Importantly, when baseline HRV was not controlled, the effects reported remained significant. At Step 2 of the HMRs, the main effects of promotion, prevention, and the dummy-coded task control conditions (i.e., low vs neutral; neutral vs high; low vs high) were entered. At Step 3, the 2-way interactions between prevention, promotion, and the dummy-coded task control conditions were entered. At Step 4, the 3-way interactions among prevention, promotion, and the dummy-coded task control conditions were entered. Finally, because HRV is often skewed, we also conducted our HMRs on natural log transformations of the HRV data. Whether the HMRs were conducted on raw or log-transformed HRV, the effects remained the same.

3.3. Main findings

In the sections below, we have reported the regression coefficients of all significant interaction terms and have included the squared semi-partial correlation (sr^2) as a measure of effect size. We followed up significant interactions with simple slopes analyses. The HMRs revealed no main effects of prevention, promotion, or the dummy-coded task control variables on any of the changes in the dependent variables between trial 1 to trial 2, or trial 2 to trial 3.

3.3.1. Moderating effects of promotion focus

Supporting Hypothesis 1a for changes in the average words written from trial 1 to trial 2, a 2-way interaction of task control (neutral vs high) and promotion focus was revealed, $ß = .261$, $t(65) = 2.068$, $p = .043$, $sr^2 = .06$, Step 3 $R^2\ \Delta = .07$, $F\ \Delta\ (3, 65) = 1.820$, $p = .152$, overall model $R^2 = .12$ (see Fig. 1). Simple slope analyses assessed the effect of promotion focus for participants in the high and neutral task control conditions. At high task control, higher promotion focus was associated with an increase in average words written from trial 1 to trial 2, $B = 11.796$, $t(65) = 2.285$, $p = .026$, whereas this was not the case at neutral task control, $B = -3.091$, $t(65) = -.063$, $p = .532$, *ns*.

3.3.2. Moderating effects of prevention focus

Supporting Hypotheses 2a and 2b on changes in task dissatisfaction from trial 1 to trial 2, a 2-way interaction of task control (low vs high) and prevention focus was revealed, $ß = .270$, $t(67) = 2.103$, $p = .039$, $sr^2 = .06$, Step 3 $R^2\ \Delta = .08$, $F\ \Delta\ (3, 68) = 1.963$, $p = .128$, overall model $R^2 = .09$ (see Fig. 2). Simple slopes assessed the effect of high and low task control conditions for participants high (+1 SD) and low (−1 SD) in prevention focus. At high prevention focus, high task control was associated with an increase while low task control was associated with a decrease in task dissatisfaction from trial 1 to trial 2, $B = .306$, $t(67) = 2.109$, $p = .039$, whereas this was not the case at low prevention focus, $B = -.0127$, $t(67) = -0.853$, $p = .397$, *ns*.

3.3.3. Combined moderating effects of prevention and promotion focus

In partial support of Hypothesis 2a on changes to the number of emails completed from trial 1 to trial 2, a 3-way interaction of task control (low vs neutral), prevention focus, and promotion focus was revealed, $ß = .321$, $t(63) = 2.292$, $p = .025$, $sr^2 = .07$, Step 4 $R^2\ \Delta = .07$, $F\ \Delta\ (1, 63) = 5.251$, $p = .025$, overall model $R^2 = .16$ (see Fig. 3). Simple slopes assessed the effect of different combinations of prevention and promotion foci among participants in the low and neutral task control conditions. At low promotion and high prevention focus, compared to neutral task control, low task control was associated with a greater increase in the number of emails completed from trial 1 to trial 2, $B = -0.787$, $t(63) = -2.456$, $p = .017$. At high promotion and high prevention focus, neutral task control, compared to low task control, was associated with a greater increase in the number of emails completed from trial 1 to trial 2, albeit marginally, $B = .429$, $t(63) = 1.984$, $p = .052$. No other comparisons were significant.

In partial support of Hypothesis 2a, on changes to HRV-HF from trial 1 to trial 2, a 3-way interaction of task control (low vs neutral), prevention focus, and promotion focus was revealed, $ß = .306$, $t(60) = 2.057$, $p = .044$, $sr^2 = .06$, Step 4 $R^2\ \Delta = .06$, $F\ \Delta\ (1, 60) = 4.230$, $p = .044$, overall model $R^2 = .16$ (see Fig. 4). Simple slopes revealed that, at low promotion and low prevention focus, compared to neutral task control, low task control was associated with less of an increase in HRV-HF

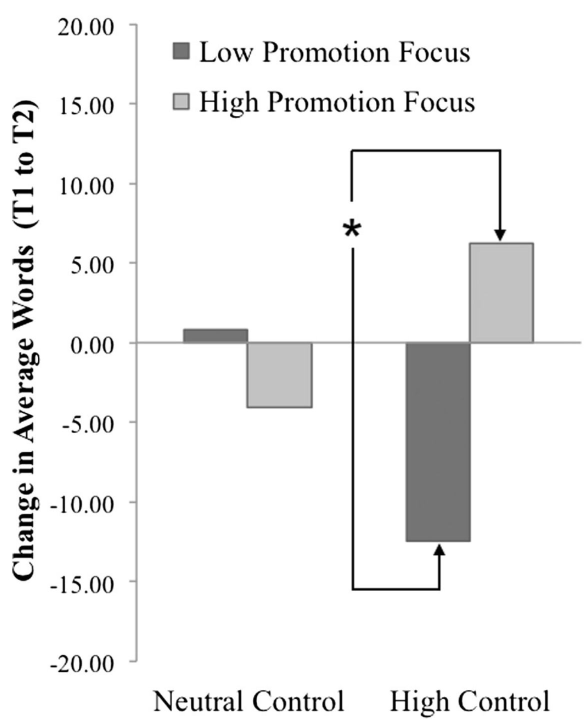

Fig. 1. Two-way interaction of task control (neutral vs high) and promotion regulatory focus on the change in average words written per email from trial 1 to trial 2. Note. *$p < .05$.

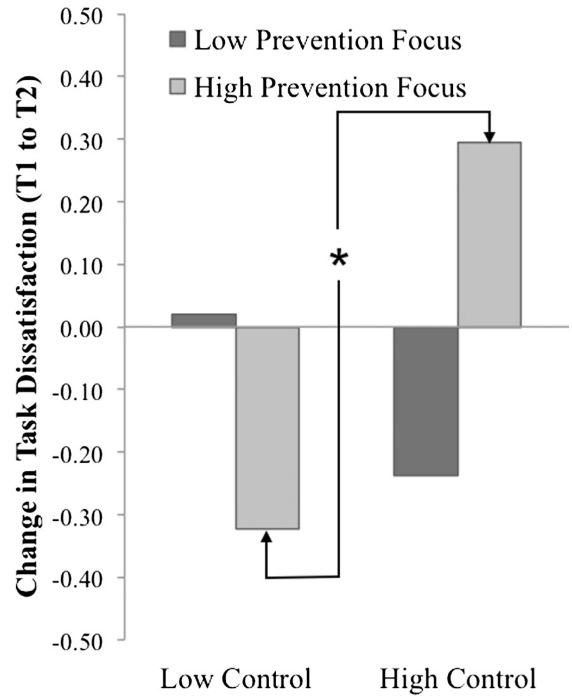

Fig. 2. Two-way interaction of task control (low vs high) and prevention regulatory focus on the change in task dissatisfaction from trial 1 to trial 2. Note. *$p < .05$.

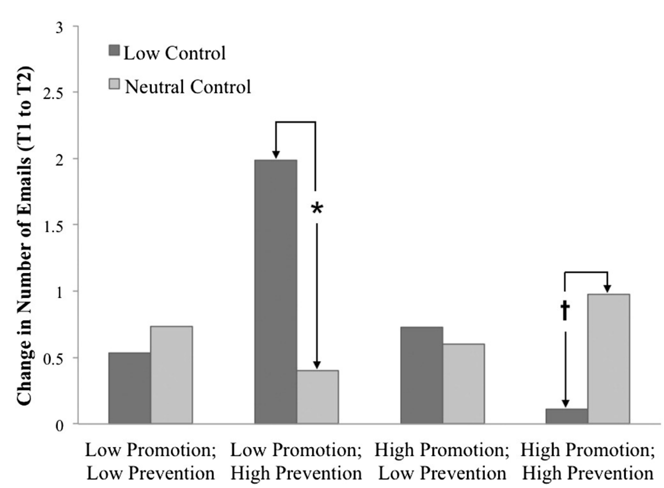

Fig. 3. Three-way interaction of task control (low vs neutral), prevention regulatory focus, and promotion regulatory focus on the change in the number of emails completed from trial 1 to trial 2. Note. *$p < .05$; †$p < .075$.

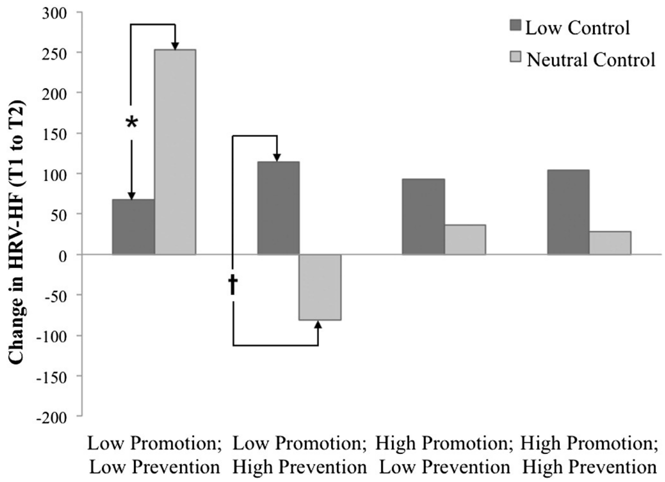

Fig. 4. Three-way interaction of task control (low vs neutral), prevention regulatory focus, and promotion regulatory focus on the change in HRV-HF from trial 1 to trial 2. Note. $^*p < .05$; $^\dagger p < .075$.

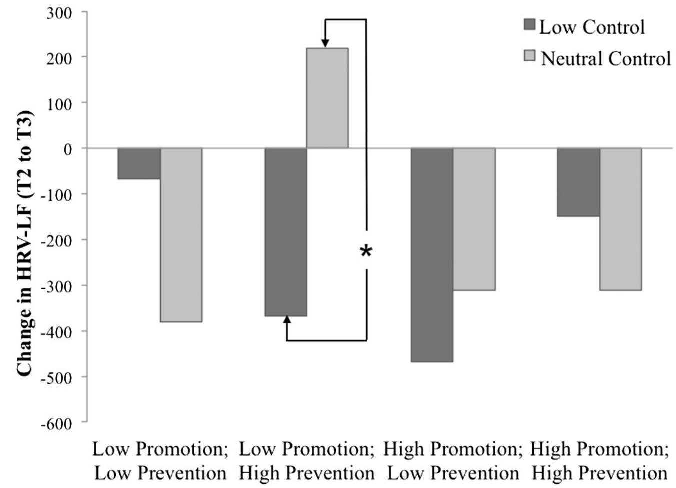

Fig. 6. Three-way interaction of task control (low vs neutral), prevention regulatory focus, and promotion regulatory focus on the change in HRV-LF from trial 2 to trial 3. Note. $^*p < .05$.

from trial 1 to trial 2, $B = 92.262$, $t(60) = 2.010$, $p = .049$. At low promotion and high prevention focus, low task control was associated with an increase in HRV-HF while neutral control was associated with a decrease in HRV-HF from trial 1 to trial 2, albeit marginally, $B = 12.66$, $t(60) = -1.881$, $p = .065$. No other comparisons were significant. Moreover, a 3-way interaction of task control (low vs neutral), prevention focus, and promotion focus, was revealed on changes in HRV-HF from trial 2 to trial 3, $ß = -.289$, $t(60) = -2.085$, $p = .041$, $sr^2 = .05$, Step 4 $R^2\ \Delta = .05$, $F\ \Delta\ (1, 60) = 4.346$, $p = .041$, overall model $R^2 = .27$ (see Fig. 5). Simple slopes revealed that, at high promotion focus and low task control, higher prevention focus increased HRV-HF, while lower prevention focus decreased HRV-HF, from trial 2 to trial 3, $B = 163.732$, $t(60) = 2.861$, $p = .006$. No other comparisons were significant.

In partial support of Hypothesis 2a, on changes to HRV-LF from trial 2 to trial 3, a 3-way interaction of task control (low vs neutral), prevention focus, and promotion focus was revealed, $ß = -.340$, $t(60) = -2.491$, $p = .016$, $sr^2 = .07$, Step 4 $R^2\ \Delta = .07$, $F\ \Delta\ (1, 60) = 6.205$, $p = .016$, overall model $R^2 = .29$ (see Fig. 6). Simple slopes revealed that, at low promotion focus and high prevention focus, neutral control increased HRV-LF from trial 2 to trial 3 while

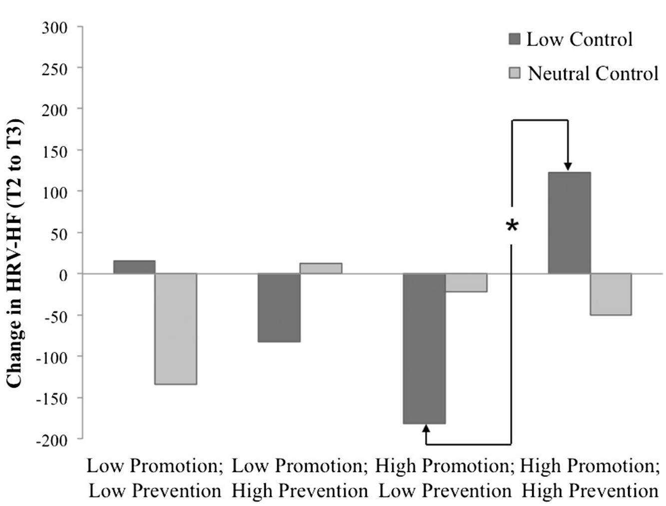

Fig. 5. Three-way interaction of task control (low vs neutral), prevention regulatory focus, and promotion regulatory focus on the change in HRV-HF from trial 2 to trial 3. Note. $^*p < .05$.

low control reduced HRV-LF, $B = 291.971$, $t(60) = 2.027$, $p = .047$. No other comparisons were significant.

4. Discussion

This study revealed that trait regulatory focus moderates the effects of task control on changes in HRV and psychological indicators of stress. First, supporting the JD–CM (Karasek, 1979), and in line with Hypothesis 1a, highly promotion-focused individuals found high (compared to neutral) task control stress-buffering for task performance (i.e., more average words written from trial 1 to trial 2). Second, contrary to the JD–CM, but in support of Hypothesis 2b, for highly prevention-focused individuals, high task control produced a stress-exacerbating effect by increasing task dissatisfaction from trial 1 to trial 2. Third, in line with Hypothesis 2a, highly prevention-focused individuals found low task control stress-buffering (i.e., more HRV-HF, more emails completed, and less task dissatisfaction from trial 1 to trial 2, and more HRV-HF and less HRV-LF from trial 2 to trial 3).

It is important to consider that this moderation of prevention focus on the effects of low task control on changes in HRV-HF, HRV-LF, and the number of emails completed, also depended on individuals' level of promotion focus. For the effects on number of emails completed and HRV-HF from trial 1 to trial 2, as well as the effects on HRV-LF from trial 2 to trial 3, Hypothesis 2a only was supported when participants also were low in promotion focus, suggesting that when individuals are higher in promotion focus this combination of regulatory foci buffers or eliminates the stress-buffering potential of low task control. Perhaps *high self-regulators* (i.e., individuals high on both prevention and promotion) possess more psychological flexibility (Bond et al., 2008, 2009) in relation to how they cope with stressful situations (i.e., not being as dependent on the levels of task control available in their work environment for adaptation to demanding work). Interestingly, from trial 2 to trial 3, support for Hypothesis 2a on HRV-HF only was found when individuals were also higher in promotion focus. This pattern of findings suggests that there are different time lags for the stress-buffering effects of low task control on HRV-HF depending on the combination of an individual's regulatory foci. These effects support recent calls for more research that examines the combined effects of different regulatory foci (Gorman et al., 2012).

Our results suggest that during demanding work, highly promotion-focused individuals find motivation in a more autonomy-supportive environment (i.e., high task control) and engage in more discretionary effort by writing more words per email (Deci and Ryan, 1987). In contrast, when task control is low, highly prevention-focused individuals find stress relief (i.e., more relaxed and less mentally taxed, as indicated by changes in HRV) in this more structured environment, especially if they are also low in promotion regulatory focus and new to the task; i.e., trials 1 and 2. These results are in accordance with regulatory-fit theory (Brockner and Higgins, 2001); such that, strict policies and procedures may have fulfilled the safety-related needs of highly prevention-focused individuals by allowing them to feel that they would meet their duties and obligations, prompting the experience of more positive emotions. This is an interesting finding, considering regulatory focus theory predicts highly prevention-focused individuals should report quiescence emotions (i.e., calmness) when their actual-ought discrepancy is reduced (Brockner and Higgins, 2001; Idson et al., 2000). This suggests that highly prevention-focused individuals might be able to experience positive emotions at work when placed within the right work structures.

Previous research has suggested that prevention focus is associated with anxiety-based emotions, which may actually offer advantages in helping individuals to be vigilant to threats in their environment (Gorman et al., 2012; Higgins, 2001). In accordance with Trait Activation Theory (Tett and Guterman, 2000), the ambiguous high control environment may have primed highly prevention-focused individuals to become more aware of threats to their *actual-ought self*. This possibility was reflected in the finding that, for highly prevention-focused individuals', high task control produced a stress-exacerbating effect (i.e., higher task dissatisfaction from trial 1 to trial 2). If providing low task control reduces threat for prevention-focused individuals, less negative emotion may further contribute to stabilizing physiological arousal, enhancing emotion regulation, and improving task performance. Considering the important links between HRV and psychological well-being (Boehm and Kubzansky, 2012; Sharpley, 2002), alleviating these sorts of concerns, which highly prevention-focused individuals might be quite accustomed to experiencing on a daily basis, through provision of low task control (i.e., more task structure), may be one explanation for higher HRV-HF over trials (and lower HRV-LF from trial 2 to trial 3) of the inbox activity. This effect could also be due to low task control being less mentally taxing for these participants (see Hoover et al., 2012; Jorna, 1992). Indeed, further experimental research that identifies the associated (or underlying) affective and cognitive processes at play is needed.

Contrary to expectations, we did not find promotion focus by task control interactions for most dependent variables (except for one performance outcome). As such, the presence or absence of a promotion focus alone might not determine the effectiveness of task control as a stress-buffer. Indeed, the 3-way interactive effects suggest individuals' promotion focus combines with their level of prevention focus in the prediction of whether low task control is stress-buffering or not. Cross-sectional research on regulatory focus has suggested promotion-focused individuals may be more capable of attaining additional resources to cope with demands both in and outside of work (Brenninkmeijer et al., 2010). Thus, perhaps work control may not be a resource valued by more promotion-focused individuals, as they already have a natural pre-disposition to seek rewarding and challenging experiences and the capacity to build a variety of different resources when undertaking demanding work. Further research is needed regarding whether this resilience remains in the absence of other types of resources or combinations of resources (i.e., lack of social support and/or performance feedback).

4.1. Theoretical and practical implications

Meta-analytical studies have proposed regulatory focus to be a key mediator of how a host of personality traits relate to work outcomes (Gorman et al., 2012; Lanaj et al., 2012). Our findings extend on this literature and contribute to the occupational stress literature on personal resources, by examining how trait regulatory focus boosts or buffers against the motivational and health impairing effects of work environments (Demerouti and Bakker, 2011). If employees' work environments provide resources for coping with stress that match with their regulatory focus, HRV is likely to improve while they adapt to demanding work, whereas this is not the case when there is regulatory "mismatch". The JD–CM posits that altering work control may help employees reduce their stress reactions, without having to alter work demands (Karasek, 1979). However the key aspect lacking in this model appears to be consideration of individual differences in work goal motivation, in particular regulatory preferences. Our results demonstrate that low task control environments may offer largely unrecognized advantages (i.e., clearer guidelines, regulations, and safety cues) for more prevention-focused individuals (especially when they are also low in promotion focus and coping with a novel and demanding work task).

4.2. Limitations and future research directions

Despite limitations (e.g., student population, artificial representation of a workplace), this study offers promising results and directions for future research. However, it is important to note that the long-term implication of regulatory fit for occupational stress remains untested. Future field research could take advantage of ambulatory HRV monitoring devices to explore these research questions with employee samples over longer time periods.

One inconsistent finding of the current study was an absence of effects on anxiety. Items assessing anxiety captured a post-task affective reaction. Alternatively, items assessing task dissatisfaction were specifically tied to each trial of the inbox task, through item wording prompting reflection on task dissatisfaction during the preceding trial. Researchers should consider measuring self-reported affect during stressful episodes rather than as affective task reactions after the stressful episode has been paused (or ceased). Moreover, researchers should also consider using HRV alongside other physiological indicators of the stress experience (i.e., cortisol, systolic blood pressure, skin temperature), as well as controlling for respiration, which can impact HRV-LF in particular (Beda et al., 2014).

4.3. Conclusions

Coping with high demands is a dynamic and unfolding process requiring the individual to adapt and utilize the resources available in their environment. As predicted, highly promotion-focused individuals found high task control stress-buffering for performance, while highly prevention-focused individuals found high task control stress-exacerbating for task dissatisfaction. In addition, highly prevention-focused individuals found low task control stress-buffering for task dissatisfaction, performance, and HRV. However, these stress-buffering effects of low task control for highly prevention-focused individuals also depended on their level of promotion focus. A greater understanding of the temporal and dynamic processes at play, in these exchanges between the individual and their environment, will better inform stress management in practice.

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