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Trait Emotional Intelligence, Self-Reported Affect, and Salivary Alpha-Amylase on Working Days and a Non-Working Day[1]

Emotional intelligence, affect, and alpha-amylase

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Abstract

This study examined the relationship between trait emotional intelligence (EI) and variation in psychological (positive affect [PA] and negative affect [NA]) and psychophysiological (salivary alpha-amylase [sAA]) indicators among Japanese employees over 3 consecutive days (working day 1, non-working day, working day 2). The analyses revealed that higher trait EI was associated across the days with higher PA, but not with NA. Moreover, diurnal sAA levels were lower in the high trait EI group than in the low trait EI group on the intervening non-working day, and this difference between the EI groups continued to show a tendency to significance on working day 2. The results indicate that higher EI may be related to the preservation of higher levels of PA and lower levels of sympathetic activity in recovery in the naturalistic condition.

Key words

affect

non-working day

recovery

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salivary alpha-amylase

trait emotional intelligence

A series of meta-analyses have indicated that emotional intelligence (EI) may be a psychological resource for human well-being and health (Martins, Ramalho, & Morin, 2010; Peña-Sarrionandia, Mikolajczak, & Gross, 2015; Sánchez-Álvarez, Extremera, & Fernández-Berrocal, 2016; Schutte, Malouff, Thorsteinsson, Bhullar, & Rooke, 2007). EI refers to the cognitive abilities to accurately perceive and express, utilize, understand, and manage one's own and others' feelings and emotions to facilitate emotional and mental development (Mayer & Salovey, 1997). The theory of EI describes in what way an individual's intellectual activity concerning emotions is related to human functioning and outcomes (Mayer & Salovey, 1997; Salovey & Mayer, 1990). The central assumption of this theory is that individuals with higher EI perform more sophisticated cognitive processing of emotional information, thereby promoting more rational and appropriate thinking and behaviors, and enriching their adaptive functions and global well-being (Mayer & Salovey, 1997; Salovey & Mayer, 1990).

The primary aims of contemporary EI research include elucidating the mechanisms responsible for better well-being and health in emotionally intelligent individuals. Exploring how EI functions in stress reduction and recovery in the daily life of individuals is thus a crucial step towards explaining the long-term effect of EI on mental and physical states. However, the role of EI in the naturalistic condition has received little research attention. In this study, we addressed this issue by focusing on the relationship between employees' EI and their global well-being in the work and recovery cycle.

To date, most EI research has been based on two major concepts, that is, ability EI and trait EI, each with its own distinctive method of measurement. Ability EI refers to cognitive capability in relation to emotions and is best measured via tests of maximum cognitive performance, whereas trait EI refers to a composite of various affective personality traits and competencies and is assessed by using self-report measures (Petrides, Pita, & Kokkinaki, 2007; Zeidner, Matthews, & Roberts, 2012). Although ability EI and trait EI are distinct psychological constructs, in current research they are generally assumed to co-exist as a complementary component of the concept of EI (Mikolajczak, Nelis, Hansenne, & Quoidbach, 2008; Schutte et al., 2007). In this study,

we focused on trait EI (assessed via a self-report scale), which has been found to predict well-being and health more strongly than ability EI (for meta-analyses, see Martins et al., 2010; Sánchez-Álvarez et al., 2016).

Trait EI is defined as a constellation of emotional self-perceptions located at the lower levels of the personality hierarchies (Petrides et al., 2007). More specifically, trait EI refers to subjective dispositions, beliefs, and experiences of one's emotional ability to identify, utilize, understand, and manage one's emotions and those of others in order to maintain well-being and facilitate adaptability to diverse environments (Petrides et al., 2016). This conceptual framework enables the construct of EI to be incorporated into the mainstream personality theories and models in differential psychology, providing a rational basis for understanding the results obtained from self-report measures of EI (Petrides et al., 2007).

The Emotional Intelligence Scale (EQS) is a self-report measure that has been well validated for Japanese employees across a variety of occupations and is widely used in Japanese EI research (Otake, Shimai, Uchiyama, & Utsuki, 2001; Uchiyama, Shimai, Utsuki, & Otake, 2001). The scale assesses three major dimensions of EI: Intrapersonal EI refers to emotional self-awareness, Interpersonal EI to the ability to perceive and empathize with another person's emotional state, and Situational EI to flexible adaptation to situational changes. In contrast to other self-report measures of EI with more emphasis on affect-laden personality traits (the Trait Emotional Intelligence Questionnaire; Petrides & Furnham, 2003) or emotional cognitive functions (the Schutte Self Report Emotional Intelligence Test; Schutte et al., 1998), the EQS was designed to cover a broad set of positive emotional traits, skills, and competencies that are linked to the maintenance of optimal well-being (Otake et al., 2001; Uchiyama et al., 2001). As the components of the EQS reflect the relatively stable tendency of a person's subjective perceptions of their emotional abilities (Uchiyama et al., 2001), it should be possible to define trait EI operationally using the EQS, particularly given the conceptual framework of trait EI. In support of this notion, several earlier studies have used the EQS as a measure of trait EI (Takeuchi et al., 2011, 2013). This type of self-report measure of EI has been demonstrated to have stronger associations with well-being and health indicators compared to other scales (Sánchez-Álvarez et al., 2016). Thus, in this study, we operationalized trait EI (henceforth EI) by applying the EQS. Theoretically, this study draws on the recovery-related theories, to be described next.

1.1. Theories of Stress and Recovery

Recovery is defined as a process by which psychological and physiological systems activated during work return to and stabilize at their pre-stressor levels, thereby reducing strain (Geurts & Sonnentag, 2006). The initiation of the recovery process can be explained by referencing the Effort–Recovery (E-R) model (Meijman & Mulder, 1998). The primary assumption of this model is that addressing one's job demands and achieving one's work goals necessitate effort, which drains energy resources and causes mental and physical stress reactions (Meijman & Mulder, 1998). When the resources available are close to exhaustion, recovery is triggered to avoid the individual becoming stressed out (Meijman & Mulder, 1998). Employee recovery usually occurs during non-work time (Meijman & Mulder, 1998), and thus non-working days may be among the occasions when mental and physical recovery are most conspicuously in evidence (Drach-Zahavy & Marzuq, 2013; Fritz, Sonnentag, Spector, & McInroe, 2010; Goldstein, Shapiro, Chicz-DeMet, & Guthrie, 1999). Successful off-job recovery dispels the detrimental effect of strain and replenishes resources depleted by work (Geurts & Sonnentag, 2006; Meijman & Mulder, 1998).

The psychosomatic mechanism of stress and recovery is well-described by the theory of allostasis (McEwen, 2007). Allostasis refers to the achievement of organismic stability (homeostasis) through internal changes (McEwen, 2007). In response to acute stressors, the organism releases physiological mediators (e.g., catecholamines) that increase cardiovascular activities that in turn facilitate adaptation to the situation. However, if exposure to a stressor becomes chronic and is not followed by recovery, it causes wear and tear on the autonomic regulators along with the elevation of various physiological mediators (see the reactive scope model in Romeo, Dickens, & Cyr, 2009), which, in turn, accelerates pathophysiological changes, such as atherosclerosis (McEwen, 2007). These theories provide insight into the importance of the sufficient recovery of the organism to maintain allostasis.

1.2.   Salivary Alpha-Amylase

The internal stress regulation system comprises the intricate dynamics of the sympathetic–adrenal–medullary (SAM) and the hypothalamic–pituitary–adrenal (HPA) axes (McEwen, 2007; Romeo et al., 2009). The HPA axis innervates the release of cortisol in response to stress and the termination of endogenous strain, whereas the SAM axis takes responsibility for provoking the fight or flight response via activation of the sympathetic nervous system (McEwen, 2007; Romeo et al., 2009). Arousal on the SAM axis induces the release of catecholamines, which subsequently stimulate the

secretion of salivary proteins, including salivary alpha-amylase (Ditzen, Ehlert, & Nater, 2014).

Salivary alpha-amylase (sAA) is a metalloenzyme secreted from the salivary glands dually innervated by the sympathetic and parasympathetic nerves (Nater, Rohleder, Schlotz, Ehlert, & Kirschbaum, 2007). The level of sAA has primarily been considered a surrogate indicator of sympathetic activity (Ditzen et al., 2014; van Veen et al., 2008). In research, the use of sAA has several advantages, such as being easier to collect and less affected by such factors as posture or hormones than cardiac indicators (Schumacher, Kirschbaum, Fydrich, & Ströhle, 2013).

Several empirical studies have demonstrated that sAA has a circadian rhythm, showing a rapid decrease around 30 min after waking and a steady increase thereafter throughout the day (Harmon, Towe-Goodman, Fortunato, & Granger, 2008; Nater et al., 2007). Moreover, although the empirical evidence remains limited, sAA activity, like that of other sympathetic indicators, including cardiovascular activity and epinephrine levels (Goldstein et al., 1999), was observed to show a lower diurnal level on weekends than weekdays (Lynn, Paris, Frye, & Schell, 2010). Regarding sAA reactivity to stress, individuals with high levels of psychological stress have shown higher diurnal sAA levels (Nater et al., 2007; van Veen et al., 2008). More interestingly, Doane and Van Lenten (2014) demonstrated that trait positive affect (PA) was a significant antecedent of a flattened diurnal level of sAA, as well as of high arousal of negative affect (NA) on the previous day. To summarize, the level of diurnal sAA may be related to contextual factors, psychological stress, and affective arousal or valence.

1.3.   EI in Stress and Recovery

A growing body of stress science studies has provided robust evidence on the salutary functionality of EI. For instance, higher EI was related to optimal stress appraisal and coping, greater sense of PA, and better subjective well-being (Martins et al., 2010; Mikolajczak & Luminet, 2008; Mikolajczak et al., 2008; Saklofske, Austin, Galloway, & Davidson, 2007), and to lower emotional distress (e.g., NA) and fewer psychosomatic complaints (Andrei & Petrides, 2013; Kafetsios & Zampetakis, 2008). In addition, several laboratory studies have reported an association of higher EI with less emotional distress (Limonero, Fernández-Castro, Soler-Oritja, & Álvarez-Moleiro, 2015) and lower psychophysiological responses (e.g., LF/HF [the ratio of low frequency to high frequency of heart rate variability] and cortisol) to stress inductions (Laborde, Brüll, Weber, & Anders, 2011; Mikolajczak, Roy, Luminet, Fillée, & de Timary, 2007). More

importantly, higher EI was also found to be associated with better affective and cardiac recovery from acute psychological stress (Fernández-Berrocal & Extremera, 2006; Limonero et al., 2015; Toyama, Yajima, & Onoda, 2014). In a related vein, Mikolajczak, Bodarwé, Laloyaux, Hansenne, and Nelis (2010) found that EI correlated positively with left frontal lobe activity, which is involved in maintaining positive emotionality and facilitating faster recovery from adverse events.

The evidence cited above has two crucial implications: First, the relationship between EI and health may not simply be a response bias due to the use of self-report measures. Second, emotionally intelligent individuals may effectively adjust their mental and physical responses when facing a major stressor. However, the functioning of EI in stress and recovery has been little studied in the naturalistic condition (e.g., in daily working life). Therefore, much less is known about how employees' EI is connected to their psychological and physiological (sympathetic) activity during a cycle comprising a working day (work) and a non-working day (recovery), in which the latter is the period when recovery is mainly expected to occur. To address this issue, we examined the relationship between EI, variation in self-reported affect (PA and NA), and sAA among Japanese employees over 3 consecutive days (working day 1, non-working day, working day 2). In contrast to most of the existing studies, which have focused on the effect of psychological stress on sAA, the present purpose was rather to explore the salutary association between EI and sAA, controlling for potential confounders, such as personal (e.g., body mass index [BMI]) and occupational (e.g., shift type) demographics.

Based on the evidence reviewed above, we hypothesized:

Hypothesis 1: Individuals with higher EI will show higher PA and lower NA than individuals with lower EI.

Hypothesis 2: Individuals with higher EI will show a lower level of diurnal sAA than individuals with lower EI.

2. Method

2.1. Participants

We recruited Japanese employees engaged in eldercare nursing from an intensive care home for the elderly. Individuals on prescription medication (e.g., adrenergic agonist or antagonist, anti-depressant) or with any acute or chronic disease (e.g., psychiatric,

cardiovascular illnesses) were excluded. The nurses volunteered their participation in the study after reading a description of the proposed research, and gave their full oral and written informed consent. They were informed that all personal information would be treated with the strictest confidentiality. The study was carried out at all times in strict accordance with the Helsinki Declaration of the World Medical Association.

A total of 45 eldercare nurses out of the 50 initially selected completed all three surveys (response rate = 90.0%). We excluded a further five participants due to their extreme sAA values (±3 *SD* from the mean; *n* = 2) or deviation from the sampling protocol (*n* = 3), leaving 40 samples for the analyses. Table 1 shows the participant demographics.

2.2.   Design and Procedure

This study was conducted in naturalistic conditions over consecutive days: working day 1 (daytime shift), non-working day, and working day 2 (daytime shift). Working day 1 was at least the fifth successive working day on the daytime shift. EI was assessed prior to the collection of saliva samples.

Participants sampled their own saliva at 8:30 a.m., 12:00 p.m., and 6:00 p.m. each day (for a review, see Harmon et al., 2008). Participants were requested to strictly follow the sampling method and the time schedule. Later, the match between the self-recorded values and sampling times was confirmed by collating the former with those automatically recorded in the measuring device. We instructed the participants to refrain from strenuous physical activities, smoking, and drinking coffee and alcohol for at least 3 hr before sampling their saliva. Eating and brushing teeth were prohibited during the 40 min before sampling. Each day, immediately after the last sampling time, the participants answered a questionnaire on daily affect.

2.3.   Sampling and measurement of sAA

The participants were carefully instructed in the saliva-sampling procedure, as described in the manufacturer's manual (Nipro Co. Ltd., Osaka, Japan). After practicing the saliva-sampling and -measuring methods, they collected their own saliva by putting a filter paper under the tongue for around 30 s and then measured the concentration of sAA (kIU/L) with a portable salivary amylase monitor (Nipro Co. Ltd., Osaka, Japan). These methods have been validated by Yamaguchi et al. (2004) and Yamaguchi, Hanawa, and Yoshida (2007).

2.4. Psychological Measures

EI was measured using the EQS (Otake et al., 2001). The scale assesses three dimensions of EI: the first, Intrapersonal EI, measures awareness of one's own emotions, as this aids various behaviors (e.g., "I know how I am feeling even at times when I become emotional"); the second, Interpersonal EI, describes the ability to maintain a positive social relationship through recognition and empathy with the feelings and emotions of others (e.g., "I am careful not to say anything that would hurt someone else's feelings"); the third, Situational EI, indicates the ability to adjust the other EI dimensions so as to cope flexibly with environmental changes (e.g., "I cope successfully with change"). The items were rated on a 4-point Likert-type scale from 0 (*totally disagree*) to 4 (*totally agree*). We used the total score of the EQS in the analyses. Cronbach's alpha was .97.

Day-level affect was assessed by the Three-Dimensional Checklist of Affect (Joh, 2008). We measured PA using the subscales of Vigor (e.g., "energetic"), Excitement (e.g., "enthusiastic"), and Relaxation (e.g., "feel at ease"), and NA using the subscales of Exhaustion (e.g., "tired"), Depression (e.g., "sad"), and Tense (e.g., "nervous"). The items were scored on a 7-point Likert-type scale from 1 (*not felt at all*) to 7 (*very strongly felt*). Cronbach's alphas for PA were: working day 1 = .85; non-working day = .91; working day 2 = .86, and those of NA were: working day 1 = .91; non-working day = .92; working day 2 = .93.

2.5. Statistical Analysis

The normality of the distributions was confirmed for EI and self-reported affect by the Kolmogorov–Smirnov test. The scores for EI were mean-split into high ($n = 21$) and low ($n = 19$), thereby forming two EI groups. Two-way repeated analyses of variance (ANOVAs) were then used to examine the difference between the EI groups in PA and NA.

Owing to a positively skewed distribution, the sAA values were transformed by the Box–Cox power transformation method. Based on these transformed values, we calculated the area under the curve with respect to ground (AUCg) with the trapezoid formulas (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). First, we conducted one-way repeated ANOVAs to investigate the diurnal and between-days variations in sAA levels. Second, we performed two-way repeated ANOVA to examine

the difference between the groups of EI in the diurnal sAA levels, where only personal and occupational demographics (sex, BMI, and shift type) that had a significant interaction effect with day or a main effect on the diurnal sAA levels in the model were processed as covariates.

For all repeated ANOVAs in cases where the data did not fulfill the assumption of Mauchly's test of sphericity, the degree of freedom was corrected using the epsilon of Greenhouse–Geisser. Statistical significance was defined as $p < .05$ and tendency to significance as $p < .10$ for all results. The effect size was reported by partial eta squared (h_p^2). All analyses were conducted using SPSS 21.0.

3.   Results

Correlations between the study variables are presented in Table 2. EI showed a positive and moderate correlation with PA across the study days, whereas EI was not associated with NA. Moreover, EI displayed a small negative correlation with sAA on working day 1 and working day 2.

3.1.   EI and Self-reported Affect

Two-way repeated ANOVA for PA revealed a significant main effect of day, $F(2, 61) = 7.95$, $p = .002$, $h_p^2 = .173$. PA showed a significant tendency to increase from working day 1 to the non-working day ($p = .087$), after which it returned to the baseline level. A main effect of EI was also significant, $F(1, 38) = 10.35$, $p = .003$, $h_p^2 = .214$.

PA in the high EI group was higher than in the low EI group across the 3 days (working day 1: $p = .007$; non-working day: $p = .029$; working day 2: $p = .025$). However, the interaction effect of EI and day was non-significant, $F(2, 61) = 0.32$, $p = .679$, $h_p^2 = .008$.

The analysis for NA revealed a significant main effect of day, $F(2, 76) = 6.52$, $p = .002$, $h_p^2 = .146$. NA was the highest on working day 1 and showed a significant decrease from working day 1 to the non-working day ($p = .005$) and working day 2

($p = .043$). However, neither the main effect of EI, $F(1, 38) = 0.17$, $p = .680$, $h_p^2 = .005$,

nor the interaction effect of EI and day, $F(2, 76) = 0.15$, $p = .863$, $h_p^2 = .004$, were

significant. Thus, the results partially supported Hypothesis 1, suggesting that the levels of PA in the high EI group were higher than those in the low EI group across the 3 days, whereas the levels of EI was irrelevant to the levels of NA. Table 3 presents the means and standard deviations of EI, affect, and the diurnal sAA levels between the EI groups.

3.2. EI and sAA

One-way repeated ANOVAs revealed that the levels of sAA gradually increased during each day. However, the main effect of time on sAA during working day 1, $F(2, 78) = 2.29$, $p = .108$, $h_p^2 = .055$, and working day 2, $F(2, 78) = 0.14$, $p = .870$,

$h_p^2 = .004$, was non-significant, although the effect was significant on the non-working

day, $F(2, 60) = 4.99$, $p = .016$, $h_p^2 = .114$. In addition, the between-days variation in

diurnal sAA was also non-significant, $F(2, 78) = 2.10$, $p = .129$, $h_p^2 = .051$. The results

indicate that the variation in sAA was relatively stable both within each day and across the 3 days.

Two-way repeated ANOVA revealed a main effect of day, $F(2, 70) = 3.22$, $p = .046$,

$h_p^2 = .084$, and EI, $F(1, 35) = 5.75$, $p = .022$, $h_p^2 = .141$. Diurnal sAA was lower in the

high EI group than in the low EI group on the non-working day ($p = .021$), and the difference between the groups continued to show a tendency to significance on working day 2 ($p = .053$). Therefore, the results partially supported Hypothesis 2. However, the interaction effect of EI and day on the diurnal levels of sAA was non-significant, $F(2,$

$70) = 0.49$, $p = .616$, $h_p^2 = .014$. In sum, the results indicate that although the

day-to-day variation in diurnal sAA was closely similar between the EI groups, diurnal sAA was likely to be lower in the high EI group than in the low EI group on the non-working day and subsequent working day. Figure 1 displays the variation between the EI groups in diurnal sAA levels.

4. Discussion

The aim of this study was to examine the relationship between EI and variation in self-reported affects and sAA among Japanese employees (eldercare nurses) over 3 consecutive days (working day 1, non-working day, working day 2). In light of prior evidence indicating the benefits of EI for health in the context of stress and recovery (Fernández-Berrocal & Extremera, 2006; Laborde et al., 2011; Mikolajczak et al., 2007; Toyama et al., 2014), we expected that the individuals with higher EI would also be better able to regulate their affect and sympathetic activity across the study days.

The analysis revealed that the level of NA was the highest on working day 1, and significantly lower on the following 2 days in both EI groups. Correspondingly, PA showed a statistical tendency to increase from working day 1 to the non-working day. These results suggest that, on the non-working day, the pronounced emotional distress experienced during the working day diminished, accompanied by a moderate upturn in affective comfort, both indicative of the affective recovery process (see Fritz et al., 2010; Sonnentag & Fritz, 2015). These findings corroborate the proposition of the E-R model that when individuals are no longer exposed to work or job demands, recovery is initiated to prevent excessive stress (Meijman & Mulder, 1998).

The further analysis yielded a main effect on PA of EI, showing its strong effect size. The individuals with higher EI had higher levels of PA than those with lower EI across the days, thereby partially supporting Hypothesis 1. This result supports a central proposition of the theory of EI that emotionally intelligent individuals successfully maintain better emotional well-being (Mayer & Salovey, 1997; Salovey & Mayer, 1990). Several empirical studies have found advantageous dispositions, specific to these individuals, in stress management. For instance, Mikolajczak and Luminet (2008) reported that emotionally intelligent individuals were more likely to appraise stress adaptively by regarding it as a challenge rather than a threat. Moreover, these individuals were also observed as using positive and active stress-coping strategies (i.e., detached, problem-focused, and rational coping) appropriate to the situation, and less likely to choose negative countermeasures, such as emotion-focused and avoidant coping (Mikolajczak et al., 2008; Peña-Sarrionandia et al., 2015; Petrides et al., 2007; Saklofske et al., 2007). Therefore, they tended to experience less stress and achieve better well-being than their lower EI counterparts (Limonero et al., 2015; Mikolajczak et al., 2008; Zeidner et al., 2012). These findings prompt speculation that high-EI

individuals are able to positively recognize and effectively deal with job stress. Possession of such adaptive cognitive behavioral resources may explain why employees with higher EI preserve greater positive emotionality throughout the cycle constituted by working and non-working days.

On the other hand, counter to our expectation (Hypothesis 1), we failed to observe a significant association between EI and NA. Thus, our results indicate a stronger association of EI with PA than NA. This finding corroborates Otake et al. (2001), who suggested that the main functions of EI pertain to positive human functioning and adaptability rather than to negative aspects of emotional experiences. Nevertheless, it is important to note that our findings do not necessarily indicate that emotionally intelligent individuals are less sensitive to negative emotions. On the contrary, they are considered open to a wide range of emotional experiences (Salovey & Mayer, 1990). Peña-Sarrionandia et al. (2015) argue that these individuals optimally adjust their susceptibility to emotion-laden information via rigorous inspection of the emotional content. Thus, they successfully regulate their emotional responses as needed.

In the diurnal variation in sAA levels, we observed a non-linear profile, with a gradual increase during each day, as also found in previous studies (Harmon et al., 2008; Irie, Kojima, & Mori, 2012). It is noteworthy that the present samples of sAA, inferred to be secreted mainly from the sublingual salivary gland area, are, irrespective of the sampling point, a more stable indicator of sympathetic activity than the sAA produced in the parotid and submandibular salivary gland areas (Yamaguchi et al., 2007).

Further analysis revealed a significant main effect of EI on diurnal sAA. On the non-working day, the level of diurnal sAA in the individuals with higher EI was lower than the level in those with lower EI. More interestingly, the difference between the two groups of individuals continued to show a tendency to significance on working day 2, thereby partially supporting Hypothesis 2. These findings indicate that individuals with higher EI may be likely to present lower sympathetic activity than their lower EI counterparts in recovery from work in the naturalistic condition, and support Mikolajczak et al. (2007), who suggest that different EI levels may lead to heterogeneous psychophysiological reactions. As reviewed previously, emotionally intelligent individuals have a propensity to implement optimal appraisal of stressful events and stress-coping strategies (Mikolajczak & Luminet, 2008; Mikolajczak et al., 2008; Petrides et al., 2007; Saklofske et al., 2007). Specifically, Mikolajczak et al. (2008) showed that high-EI individuals tend to adopt efficacious strategies both to downregulate negative emotions and to maintain positive emotions, and so experience

negative emotions less and positive emotions more. In our study, we observed that the individuals with higher EI displayed markedly greater PA across the study days. According to Fredrickson (2004), positive emotionality leads to the expansion of the breadth of cognitions and actions and enriches mental, physical, and social resources, processes which contribute to psychological and physiological resiliency. Earlier psychobiological studies reported a salutary effect of positive emotion on reducing and on recuperating from sympathetic distress (Doane & Van Lenten, 2014; Tugade & Fredrickson, 2004). More notably, Tugade and Fredrickson (2004) found that positive emotion fully mediated the relationship between psychological resilience and sympathetic activity in recovery from acute emotional distress. Note that psychological resilience shows a close similarity with EI in its facilitation of human well-being and adaptation (Tugade & Fredrickson, 2004). Accordingly, it could be argued that higher PA, which higher EI induces (Salovey & Mayer, 1990), may be a key affective resource enabling more effective coping with sympathetic arousal.

Several empirical studies have suggested that among employees with stressful jobs, such as nursing, relaxation with sympathetic withdrawal, leading to the dominance of parasympathetic activity on non-working days, may be essential for their successful recovery from work (Chung et al., 2012; Drach-Zahavy & Marzuq, 2013; Goldstein et al., 1999). On the other hand, repeated or prolonged exposure to a heavy work load without sufficient recovery may manifest as dysregulation of the internal stress system, such as chronic sympathetic activation, which has a high association with health impairment (McEwen, 2007; Romeo et al., 2009). These indications highlight the central importance of sympathetic unwinding not only in recovery but also more generally in the adaptation of the organism to stress. On this view, our findings indicate the possibility that high EI may contribute to affective and physical wellness on a daily basis. If so, this could be a component of the long-term mechanism through which individuals high in emotional intelligence display better well-being and health. Thus, further research using sufficiently large longitudinal samples and advanced analytical tools are needed to illuminate the causal relationship between the phenomena observed in this study.

5.   Limitations

Several limitations should be considered when interpreting these results. First, the small female-dominated sample may lack sufficient statistical power, thereby restricting the

generalizability of the findings. Second, as employee recovery was indirectly speculated from the variation in PA and NA across the 3 days, its factual basis is arguable. Third, although we asked the participants to avoid physical activities and various other habits prior to saliva-sampling, uncertainty remains as to compliance. Fourth, we collected saliva samples during only one cycle of 2 working days and an intervening non-working day. Nevertheless, in accordance with previous studies (Harmon et al., 2008; Irie et al., 2012), our sample yielded only minor variations in sAA levels around the area of the sublingual salivary gland. On the other hand, given the evidence that methodological elements (e.g., duration and sampling location) can induce substantial measurement error (Harmon et al., 2008), it is arguable whether the present saliva specimen is the best choice for assessing diurnal sAA. Fifth, because we excluded participants with potential hindrances (i.e., medication use and medical history) to the production of diurnal sAA prior to the data collection, we were specifically correcting for significant personal and occupational demographic factors rather than psychiatric factors (e.g., anxiety, stress, and depression) in the analysis. Notwithstanding, it is highly likely that in addition to these factors, other personal and occupational factors (e.g., menstrual cycle, physical activities, and job demands) could also affect participants' sAA levels or mediate the relationship between EI and sAA.

6.   Conclusion

Despite its limitations, this study provides the first evidence on the relationship of EI with variation in self-reported (positive and negative) affect and sAA in the work and recovery cycle. The results indicate that emotionally intelligent individuals may maintain greater PA and show lower sympathetic activity than their lower EI counterparts in the process of recovery from work. These findings offer a novel perspective on the functionality of EI by suggesting its potential link with positive emotionality and the internal stress regulation system (SAM axis) in recovery in the naturalistic condition. Future studies aimed at producing more robust evidence would benefit from careful consideration of the methodological concerns noted in this study.

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Table 1 Personal and occupational demographics of the participants

	Total	High EI group	Low EI group
	($N = 40$)	($n = 21$)	($n = 19$)
Age (years)	33.7 ± 10.9	32.5 ± 10.6	35.1 ± 11.3
BMI (kg/m^2)	23.3 ± 4.6	23.7 ± 4.8	23.3 ± 4.6
Average sleep (hr)[a]	6.3 ± 0.9	6.4 ± 0.9	6.2 ± 0.9
Sex			
Female	32 (80.0%)	15 (71.4%)	17 (89.5%)
Male	8 (20.0%)	6 (28.6%)	2 (10.5%)
Smoking			
Smoker	12 (30.0%)	5 (23.8%)	7 (36.8%)
Non-smoker	28 (70.0%)	16 (76.2%)	12 (63.2%)
Employment type			
Permanent	35 (87.5%)	19 (90.5%)	16 (84.2%)
Contract	4 (10.0%)	2 (9.5%)	2 (10.5%)

Part-time	1 (2.5%)	0 (0.0%)	1 (5.3%)
Shift type			
Regular daytime	11 (27.5%)	5 (23.8%)	6 (31.6%)
Irregular daytime	3 (7.5%)	3 (14.3%)	0 (0.0%)
Regular night	3 (7.5%)	3 (14.3%)	0 (0.0%)
Irregular daytime and night	23 (57.5%)	10 (47.6%)	13 (68.4%)

Note. BMI = body mass index.

[a]Mean hours of sleep per day over the 3 days.

Table 2 Zero-order correlation coefficients between all study variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. EI													
2. Sex[a]	−.34*												
3. BMI	.24	−.27											
4. Shift type[a]	.02	−.10	.10										
5. PA working day 1	.44**	−.34*	.22	−.15									
6. PA	.37*	.00	.11	−.14	.50								

	1	2	3	4	5	6	7	8	9	10	11	12
non-working day					**							
7. PA working day 2	.36*	−.29	.12	.18	.57**	.30						
8. NA working day 1	.07	−.25	−.03	.16	−.03	−.05	.10					
9. NA non-working day	.03	−.32*	−.15	.11	−.07	−.48**	.14	.52**				
10. NA working day 2	.09	−.22	.10	.54**	−.25	−.20	.15	.68***	.51**			
11. sAA Working day 1[b]	−.27#	−.43**	.32*	−.05	−.19	−.01	.01	.12	.19	.05		
12. sAA non-working day[b]	−.20	−.07	−.29	−.38*	−.47**	−.08	−.19	.14	.01	.34*	.45**	
13. sAA working day 2[b]	−.28*	−.39*	.24	.03	−.40*	−.43**	−.14	.23	.46**	.31	.51**	.55***

Note. EI = trait emotional intelligence; BMI = body mass index; PA = positive affect; NA = negative affect; sAA = area under the curve with respect to ground of salivary alpha-amylase based on the power-transformed values.

[a]Spearman's correlation coefficients for the dummy-coded variables (sex: 1 = males, 2 = females; shift type: 1 = regular daytime, 2 = irregular daytime, 3 = regular night, 4 = irregular daytime and night).

[b]The AUCg of sAA is based on the power transformed values.

#$p < .10$

*$p < .05$

**$p < .01$

***$p < .001$.

Table 3 Descriptive statistics (M, SD)

	Total		High EI group		Low EI group	
	($N = 40$)		($n = 21$)		($n = 19$)	
	M	*SD*	*M*	*SD*	*M*	*SD*
EI	106.5	39.6	134.7	28.9	75.3	22.7
PA						
Working day 1	43.0	10.2	47.0	10.5	38.6	7.8
Non-working	47.7	14.2	52.2	16.8	42.6	8.4

day						
Working day 2	39.8	9.4	42.9	9.9	36.4	7.5
NA						
Working day 1	45.4	14.3	44.8	13.9	46.1	15.0
Non-working day	38.3	12.4	38.0	14.7	38.6	9.5
Working day 2	40.8	13.8	39.5	16.0	42.2	11.1
AUCg of sAA (kIU/L)[a]						
Working day 1	43.7	8.2	43.2	8.2	44.3	8.5
Non-working day	41.4	8.7	39.3	8.1	43.6	9.0
Working day 2	43.7	7.3	42.6	6.6	45.0	8.0

Note. EI = trait emotional intelligence; PA = positive affect; NA = negative affect; AUCg = area under the curve with respect to ground; sAA = salivary alpha-amylase.

[a]The AUCg of sAA is based on the power transformed values.

Figure 1. Differences between the high ($n = 21$) and low ($n = 19$) EI groups in diurnal sAA levels. *Note.* [#]$p < .10$ (vs. the high EI group). *$p < .05$ (vs. the high EI group).