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Sensory Processing Sensitivity Moderates the Relationships Between Life Skills and Depressive Tendencies in University Students[1]

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Abstract: University students often experience depressive symptoms, and strengthening of life skills may be beneficial for improving their mental health. Several studies have suggested that life skills effective in reducing depressive tendencies vary by individuals depending on differences in sensory processing sensitivity (SPS). SPS is a genetically determined trait characterized by sensitivity and reactivity to environmental stimuli. This study investigated the relationship between life skills and depressive tendencies based on individual differences in SPS. A total of 868 Japanese university students (mean age = 19.8 years, *SD* = 1.3 years) completed a questionnaire measuring levels of SPS—decision-making, interpersonal relationships, effective communication, and emotional coping skills—and depressive tendencies. Hierarchical multiple regression and simple slopes analyses indicated that interpersonal relationship skills were negatively correlated with depression regardless of SPS levels. Furthermore, decision-making skills were negatively correlated with depressive tendencies only in low-SPS students. Emotional coping skills were negatively correlated with depressive tendencies in high-SPS students. These results may help universities incorporate SPS levels when creating life-skills-based interventions for students.

Key words: sensory processing sensitivity, highly sensitive person, life skills, depression, university students.

Young adults are expected to establish their personal identities and, as such, they must focus continuously on personal growth. This could lead to them experiencing more psychological stress (Sakamoto, 1999) and, consequently, they are more likely to also experience depressive symptoms than the general population (Avenevoli, Swendsen, He, Burstein, & Merikangas, 2015; Nippon Foundation Suicide Prevention Project, 2019). University students are often exposed to various stressors, such as changes in their lifestyles and interpersonal relationships, job-hunting, and academic pressures (Kitami & Mori, 2010; Kreß, Sperth, Hofmann, & Holm-Hadulla, 2015). Additionally, recent studies performed with university students have suggested that smartphone use can be a predictor of the severity of potential depressive tendencies (Demirci, Akgönül, & Akpinar, 2015). Thus, contemporary university students could experience more stressors than students

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in past generations. Recent studies have even indicated that university students in the last decade (Tsukahara, 2011; Yano & Oishi, 2018) have a higher prevalence of depression than students in the 1970s (Fukuda & Kobayashi, 1973) and 1990s (Sakamoto, Kijima, Tomoda, & Kambara, 1998). Yet, according to a survey conducted by the World Health Organization (WHO), fewer than 17% of university students with serious depression are able to receive treatment in a clinical setting (Auerbach et al., 2016). Therefore, several studies have indicated that the approach to improving mental health provided by universities is expected to prevent and/or reduce depressive tendencies among students (Oikawa & Sakamoto, 2007; Rohde, Brière, & Stice, 2018; Shiraishi, 2005).

Approaches to improving mental health in university settings have several potential merits, such as (a) targeting many students at the same time; (b) reducing students' fears of being stigmatized while in a clinical mental health setting; and (c) providing students with the chance to interact, which may promote better understanding of the self and others (Cardemil & Barber, 2001; Oikawa & Sakamoto, 2007). Thus, school-based approaches to improving mental health could play an important role in reducing depressive tendencies among university students.

The Role of Life Skills in Reducing Depressive Tendencies

Life-skills training (LST) may be an effective school-based approach to improving mental health among university students. Life skills are the abilities needed to engage in adaptive and positive behaviors, which enable individuals to deal effectively with the challenges of everyday life (WHO, 1994). According to the framework provided by the WHO (1994), life skills comprise of 10 basic categories: decision-making, problem-solving, creative thinking, critical thinking, effective communication, interpersonal relationship skills, self-awareness, empathy, coping with emotion, and coping with stress. Previous studies have demonstrated that improving life skills can reduce depressive tendencies. For example, studies on adolescents or young adults have shown that an LST program significantly reduced depressive tendency levels, in which the effect sizes between pre- and post-tests were $d = 0.36$ to 1.04 (Rohde, Clarke, Mace, Jorgensen, & Seeley, 2004; Savoji & Ganji, 2013). These effect sizes are similar to or larger than those of other types of interventions, such as physical exercise programs (standardized mean differences [SMD] = 0.48; Carter, Morres, Meade, & Callaghan, 2016) and mindfulness-based stress reduction (SMD = 0.45; Chi, Bo, Liu, Zhang, & Chi, 2018).

In Japan, a short-term longitudinal study reported that improving life skills can also strengthen one's sense of coherence, which plays a role in promoting mental and physical health (Kase, Ueno, Shimamoto, & Oishi, 2019). Furthermore, several systematic and meta-analytic reviews have also suggested that life skills can decrease depressive tendencies and their related unhealthy behaviors (i.e., use/misuse of alcohol, tobacco, and/or drugs; Botvin & Griffin, 2015; Singla et al., 2019).

Although LST usually aims to improve the 10 skills it comprises comprehensively, it may be more effective to focus on specific skills according to the purpose of, or the participants in, an LST program (Fagan & Mihalic, 2003; WHO, 1994). For instance, an LST program aimed at reducing depressive tendencies should focus on the skills that are most strongly related to the mental health challenges associated with depression, such as coping with emotion and stress. Additionally, the degree to which participants benefit from an LST program often differs according to the participants' personalities (Greven et al., 2019; Oikawa & Sakamoto, 2007; Pluess, 2015). Therefore, personality assessments of participants could provide key information for constructing an LST program, and consequently may enable mental health support providers to intervene more effectively (Kase, Ueno, & Oishi, 2017).

Sensory Processing Sensitivity in the Context of LST

Recently, many researchers have argued that sensory processing sensitivity (SPS)[3] should be taken into consideration when designing psychological interventions, such as an LST program (Aron, Aron, & Jagiellowicz, 2012; De Villiers, Lionetti, & Pluess, 2018; Greven et al., 2019; Pluess, 2015; Takahashi, 2016). SPS is a basic trait that describes differences in sensitivity and reactivity to environmental stimuli, which could also indicate underlying individual differences in personality development (Aron & Aron, 1997; Pluess, 2015; Wolf, Van Doorn, & Weissing, 2008). Greven et al. (2019) explained that "environment" in the context of SPS has four facets: physical environments (e.g., food intake), social environments (e.g., other people's moods), sensory environments (e.g., auditory input), and internal events (e.g., bodily sensations, such as pain). Individuals with high SPS are often characterized by inhibited behavior, greater awareness of subtle stimuli, deeper processing of environmental stimuli, and stronger emotional reactions (Aron & Aron, 1997; Aron et al., 2012). Although these characteristics have led to the confusion of SPS with other personality traits, such as neuroticism or introversion, many studies have revealed that while SPS is associated with these traits, it is not identical (Aron & Aron, 1997; Lionetti et al., 2019; Listou Grimen & Diseth, 2016; Smolewska, McCabe, & Woody, 2006; Sobocko & Zelenski, 2015; Takahashi, 2016).

[3]The three psychological constructs have been developed to describe individual differences in sensitivity to environmental stimuli: (a) Sensory Processing Sensitivity (Aron & Aron, 1997); (b) Differential Susceptibility Theory (Belsky, 1997); and (c) Biological Sensitivity to Context (Boyce & Ellis, 2005). Since these constructs are similar to each other in the conceptual definition, Pluess (2015) utilized these constructs and provided a meta-framework of Environmental Sensitivity. Several studies have suggested that SPS could be a marker for Environmental Sensitivity (Greven et al., 2019; Slagt, Dubas, van Aken, Ellis, & Deković, 2018); therefore, this study consistently uses the words "sensory processing sensitivity" or its abbreviation "SPS," rather than "environmental sensitivity."

There are two main reasons to consider a participant's level of SPS in the context of an LST program: (a) SPS could predict various health-related indices, and (b) SPS could indicate individual differences in the beneficial effects from psychological interventions. Many studies have revealed that SPS is correlated with mental health concerns, such as stress (Benham, 2006), depression (Liss, Timmel, Baxley, & Killingsworth, 2005; Yano, Kase, & Oishi, 2019; Yano & Oishi, 2018), and affectivity (Acevedo et al., 2014; Jagiellowicz, Aron, & Aron, 2016). Additionally, SPS has been shown to moderate the beneficial effects from psychological interventions. For instance, cognitive behavioral approaches aimed at preventing depression and maladaptive behaviors may be more effective for high-SPS individuals than for low-SPS individuals (Nocentini, Menesini, & Pluess, 2018; Pluess & Boniwell, 2015). Conversely, other mental health interventions may be less effective based on levels of SPS, such as 10 min of physical exercise, which was shown to improve psychological mood in low-SPS groups, but not in high-SPS groups (Amemiya & Sakairi, 2018).

These findings suggest that the types of approaches effective for improving mental health differ according to individual differences in SPS levels; that is, the best choice of which life skills to focus on when constructing an LST program may differ between high- and low-SPS individuals. However, since most studies have focused on high-SPS individuals (Bakker & Moulding, 2012; Brindle, Moulding, Bakker, & Nedeljkovic, 2015; Yano et al., 2019; Yano & Oishi, 2018), further studies should pay attention to low-SPS individuals and provide the findings for reducing their depressive tendency levels (Greven et al., 2019; Lionetti et al., 2018).

The Purpose of This Study

School-based approaches, such as LST programs, are expected to be effective for reducing depressive tendencies among university students. Although research has suggested that these approaches to improving mental health should consider individual differences in SPS levels (Greven et al., 2019), it is not clear which life skills are most effective for either high-SPS or low-SPS individuals when reducing

depressive tendencies. Therefore, this study aimed to investigate the relationship between life skills and depressive tendencies, as well as how this relationship may be moderated by individual levels of SPS in Japanese university students. Since the types of life skills effective for reducing depressive tendencies may differ between high- and low-SPS individuals, we decided to consider each subscale of life skills in this study. The results of this study may have implications for developing more effective LST programs for both high- and low-SPS individuals in university settings.

Methods

Participants and Procedure

Participants were recruited by using the market research company Cross Marketing, Inc., who also explained to them the purpose of this study. A total of 868 university students (385 men and 483 women; mean age = 19.8 years, SD = 1.3 years), all of whom were registered as a web survey monitor at that time, from all prefectures of Japan provided their consent and completed an anonymous online survey in June 2019. As no participants provided incomplete or invalid responses (e.g., the same answers for the entire scale), results from all the participants were analyzed. This study was approved by the ethics committee of the first author's university (KOMI19001A).

Measures

Japanese version of the 19-item Highly Sensitive Person Scale. SPS was assessed using the Japanese version of the Highly Sensitive Person Scale (HSPS-J19; Takahashi, 2016), which was revised from the English version originally created by Aron and Aron (1997). This scale comprises 19 items (e.g., "Are you bothered by intense stimuli like loud noises or chaotic scenes?"), and each item is assessed on a 7-point Likert scale, with higher scores indicating higher SPS. Although Takahashi (2016) adopted the three-factor model of HSPS-J19 (low sensory threshold, ease of excitation, and aesthetic sensitivity), a recent study has argued for the bi-factor model with the "General Sensitivity" factor (Lionetti et al., 2018). Given the purpose of this study, we considered all of the aspects of SPS (i.e., general sensitivity) in a comprehensive manner, rather than considering any single subscale. Therefore, this study used the total score of the HSPS-J19 (not the scores of each subscale) as the participants' levels of SPS.[4] The Cronbach's α coefficient was .86 in this study.

Life Skills Scale for Adolescents and Adults. Life skills were assessed using the Life Skills Scale for Adolescents and Adults (LSSAA; Kase, Iimura, Bannai, & Oishi, 2016b).[5] Prior to the development of this scale, Kase, Bannai, and Oishi (2016a) identified characteristics of life skills in Japanese adults by using the framework for life skills as defined by the WHO (1994) and research by Brooks (1984) as references. As the LSSAA was developed based on the results of a study by Kase, Bannai, & Oishi (2016a), this scale can be considered to reflect the characteristics of Japanese adults as well as to correspond with the international definition of "life skills" (Kase et al., 2019). The LSSAA consists of 21 items across four subscales: (a) Decision-Making Skills (i.e., skills necessary to solve problems effectively by planning and summarizing knowledge; eight items; e.g., "I can think carefully about the pros and cons of things"), (b) Interpersonal Relationship Skills (i.e., skills involving imagining others' emotions and

[4]Prior to the statistical analyses, in order to validate the use of the total HSPS-J19 score, the authors compared the fit indices in the bi-factor model with those in the three-factor model (Lionetti et al., 2018; Ueno, Takahashi, & Oshio, 2019). The results showed that the bi-factor model had better fit indices than the three-factor model: $\chi^2(133) = 806.90$, $p < .001$, CFI = .89, RMSEA = .08, AIC = 920.90 for the bi-factor model; $\chi^2(149) = 1{,}356.95$, $p < .001$, CFI = .80, RMSEA = .10, AIC = 1,438.95 for the three-factor model. These findings are consistent with Lionetti et al. (2018) and Ueno et al. (2019), and provide the validity to use the total score of HSPS-J19 in the following analyses.

[5]The Daily Life Skills Scale for College Students (Shimamoto & Ishii, 2006) has also been used to assess the levels of life skills among university students. However, because the LSSAA can be adapted to not only be relevant to students but also to individuals who have graduated from universities, we decided to use this scale.

expressing empathy and consideration; five items; e.g., "I can speak and act with consideration for the feelings of others"), (c) Effective Communication Skills (i.e., skills involving expressing one's own thoughts and feelings to others actively and effectively; five items; e.g., "I can clearly convey my true feelings to others"), and (4) Emotional Coping Skills (i.e., skills representing the effective control of one's own emotions, such as positive thinking and emotional regulation; three items; e.g., "I am able to control my emotions, for example, by calming myself down").

As mentioned in the Introduction, the scores of each subscale, not the total score of the LSSAA, were used in statistical analyses for the present study. Each item was assessed on a 5-point Likert scale, with higher scores indicating higher skills. The Cronbach's α coefficients were .87, .85, .72, and .79 for Decision-Making Skills, Interpersonal Relationship Skills, Effective Communication Skills, and Emotional Coping Skills, respectively.

Japanese version of the Center for Epidemiologic Studies Depression Scale. Depressive tendencies were assessed using the Japanese version of the Center for Epidemiologic Studies Depression Scale (CES-D; Shima, Shikano, Kitamura, & Asai, 1985), which is a version of Radloff's (1977) original scale that has been revised for use with Japanese individuals. This scale comprises 20 items, with higher scores indicating higher depressive tendencies. Each item is assessed on a 4-point Likert scale from 0 (*none or less than 1 day*) to 3 (*always or more than 5 days*). Each point represents the frequency each week that an individual experiences the depressive symptoms indicated in each item. The Cronbach's α coefficient was .90 in this study.

Short Form of the Japanese Big Five Scale. As SPS is correlated with neuroticism and introversion, the effects of these traits should be controlled for (Jagiellowicz et al., 2016). In particular, neuroticism has strongly been recommended to be controlled for, since HSPS and its Japanese version (i.e., HSPS-J19) use many negative words, such as "annoyed," "nervous," and "uncomfortable" (Aron et al., 2012). Furthermore, a recent meta-analytic review reported that HSPS did not significantly correlate with extraversion (contrary to introversion; Lionetti et al., 2019). Therefore, this study used neuroticism as a control variable when its relation to SPS was significant. The trait of neuroticism, as presented on the short form of the Japanese Big Five Scale (Namikawa et al., 2012), was assessed using its corresponding subscale, which includes five items. Each item was assessed on a 7-point Likert scale, with higher scores indicating higher neuroticism. The Cronbach's α coefficient was .82 in this study.

Statistical Analyses

First, descriptive analyses were conducted to summarize measurement scores. Second, Pearson's product moment correlation coefficients were calculated to examine the bivariate relationships among levels of SPS, life skills, depressive tendencies, and neuroticism. Finally, hierarchical multiple regression analysis was conducted to examine the moderating effect of SPS on the relationship between life skills and depressive tendencies. All statistical analyses were performed using a free statistical software program, HAD Version 16.05 (Shimizu, 2016), and the level of significance was set at 5%.

Results

The mean scores, 95% confidence intervals (CI), standard deviations (*SD*), and range of observed scores for each variable are shown in Table 1. The results of correlation analysis between all variables are also shown in Table 1. Depressive tendencies were positively correlated with SPS and neuroticism and negatively correlated with each life skill. SPS was positively correlated with neuroticism and negatively correlated with effective communication skills and emotional coping skills. Therefore, neuroticism was controlled for in the following analysis. Each life skill was negatively correlated with neuroticism, as well as positively intercorrelated.

Hierarchical multiple regression analysis to predict depressive tendencies was performed (Table 2). The following predictor variables were

Table 1 Descriptive statistics and intercorrelations for all variables

	1	2	3	4	5	6	7
1. HSPS-J19							
2. Decision	−.08*						
	[−.14, −.01]						
3. Relationships	−.07	.50***					
	[−.13, .001]	[.46, .55]					
4. Communication	−.19***	.50***	.51***				
	[−.25, −.12]	[.45, .55]	[.46, .56]				
5. Coping	−.38***	.41***	.45***	.51***			
	[−.44, −.32]	[.35, .46]	[.40, .50]	[.46, .56]			
6. CES-D	.47***	−.29***	−.31***	−.40***	−.56***		
	[.42, .52]	[−.35, −.23]	[−.37, −.25]	[−.45, −.34]	[−.61, −.51]		
7. Neuroticism	.57***	−.15***	−.14***	−.37***	−.56***	.57***	
	[.52, .61]	[−.21, −.08]	[−.20, −.07]	[−.43, −.31]	[−.61, −.52]	[.52, .61]	
Mean	81.2	27.4	18.3	14.9	8.9	18.8	24.7
	[80.1, 82.3]	[27.0, 27.7]	[18.0, 18.5]	[14.6, 15.2]	[8.7, 9.0]	[18.1, 19.6]	[24.3, 25.1]
SD	16.6	5.6	3.9	4.0	2.9	11.2	6.0
Range	30–130	8–40	5–25	5–25	3–15	0–57	5–35

Notes. Values in square brackets are 95% confidence intervals. HSPS-J19 = Japanese version of the 19-item Highly Sensitive Person Scale; Decision = Decision-Making Skills; Relationships = Interpersonal Relationship Skills; Communication = Effective Communication Skills; Coping = Emotional Coping Skills; CES-D = Center for Epidemiologic Studies for Depression Scale.
* $p < .05$, *** $p < .001$.

subsequently entered into the regression model: control variables (i.e., gender, age, and neuroticism) in the first step, SPS in the second step, each life skill in the third step, and the interaction terms between SPS and each life skill in the fourth step. Gender was used as a dummy variable, with "1" representing men and "2" representing women. All the coefficients of determination (R^2s) and their increase (ΔR^2) were significant in each step (ps < .001), and no multicollinearity was found between any predictor variables (variance inflation factor [VIF] = 1.01–2.01). The detailed statistics (e.g., precise p-values or unstandardized coefficients) are shown in Supporting Information (Tables S1–S3).

As the interaction terms between the HSPS-J19 and decision-making skills or emotional coping skills were significantly associated with depressive tendencies, simple slopes of these skills were tested. First, decision-making skills were negatively associated with depressive tendencies when SPS was low (i.e., 1 *SD* below mean; $B = -0.37$, B standard error [SE] = .09, β = −.19, 95%CI [−.27, −.10], $p < .001$); however, the significant association was not found when SPS was high (i.e., 1 *SD* above mean[6]; $B = 0.09$, $BSE = .08$, β = .04, 95%CI [−.03, .12], $p = .26$; Figure 1). Second, emotional coping skills were negatively associated with depressive tendencies when SPS was high (i.e., 1 *SD* above mean; $B = -1.47$, $BSE = .16$, β = −.38, 95%CI [−.46, −.30], $p < .001$); however, the significant association was not found when SPS was low (i.e., 1 *SD* below mean; $B = -0.18$, $BSE = .18$, β = −.05, 95%CI [−.14, .05], $p = .34$; Figure 2).

Discussion

Our study used a cross-sectional approach to investigate the moderating effects of SPS on the association between life skills and

[6]Relative to a group, people who score in approximately the top 20% on SPS are often referred to as "highly sensitive persons" (HSPs; Aron & Aron, 1997). However, Aron, Aron, and Davies (2005) reported that the proportion of HSPs in a group varied according to the samples, ranging from 10% to 35%. The proportion of high-SPS individuals in our sample (i.e., mean + 1*SD*) was 14.40%; therefore, our definition of high-SPS individuals could be acceptable.

Table 2 Hierarchical multiple regression analysis predicting depressive tendencies

	Step 1		Step 2		Step 3		Step 4	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Step 1								
Gender	.006	[−0.05, 0.06]	−.02	[−0.07, 0.04]	−.02	[−0.07, 0.03]	−.02	[−0.07, 0.03]
Age	−.05	[−0.10, 0.007]	−.04	[−0.09, 0.01]	−.04	[−0.09, 0.01]	−.04	[−0.08, 0.01]
Neuroticism	.57***	[0.51, 0.62]	.45***	[0.38, 0.51]	.28***	[0.21, 0.35]	.30***	[0.23, 0.36]
Step 2								
HSPS-J19			.22***	[0.16, 0.29]	.21***	[0.15, 0.27]	.22***	[0.16, 0.28]
Step 3								
Decision					−.07*	[−0.13, −0.006]	−.07*	[−0.13, −0.01]
Relationships					−.09**	[−0.16, −0.03]	−.11***	[−0.17, −0.05]
Communication					−.06	[−0.13, 0.006]	−.06	[−0.13, 0.001]
Coping					−.23***	[−0.30, −0.15]	−.21***	[−0.28, −0.14]
Step 4								
HSPS-J19 × Decision							.14***	[0.07, 0.20]
HSPS-J19 × Relationships							−.06	[−0.12, 0.005]
HSPS-J19 × Communication							−.02	[−0.09, 0.05]
HSPS-J19 × Coping							−.19***	[−0.26, −0.13]
R^2	0.33***		0.36***		0.46***		0.50***	
ΔR^2			0.03***		0.10***		0.04***	

Notes. Gender was used as a dummy variable (1 = men, 2 = women). HSPS-J19 = Japanese version of the 19-item Highly Sensitive Person Scale; Decision = Decision-Making Skills; Relationships = Interpersonal Relationship Skills; Communication = Effective Communication Skills; Coping = Emotional Coping Skills.
* $p < .05$, ** $p < .01$, *** $p < .001$.

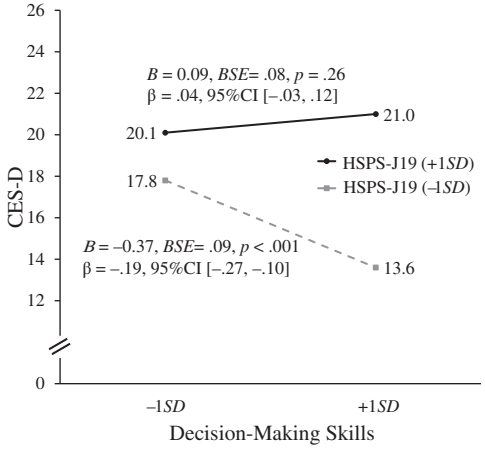

Figure 1 Interaction between Japanese version of the 19-item Highly Sensitive Person Scale (HSPS-J19) and decision-making skills predicting depressive tendencies. CES-D = Center for Epidemiologic Studies for Depression Scale.

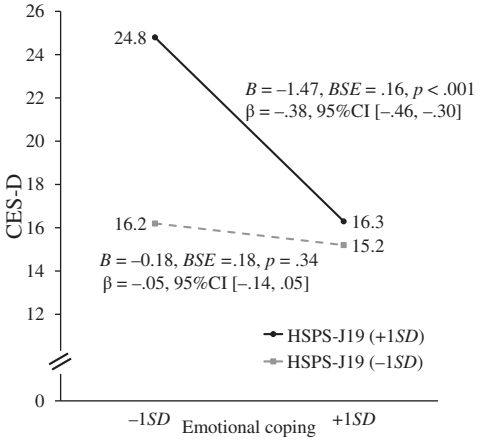

Figure 2 Interaction between Japanese version of the 19-item Highly Sensitive Person Scale (HSPS-J19) and emotional coping skills predicting depressive tendencies. CES-D = Center for Epidemiologic Studies for Depression scale.

depressive tendencies in Japanese university students. The results have implications for constructing LST programs aimed at reducing depressive tendencies among university students. First, SPS was positively associated with depressive tendencies (Table 2), which supports results found in previous studies (Liss et al., 2005; Yano & Oishi, 2018). Particularly, our study indicates the association between SPS and depressive tendencies, even when controlling for the effects of neuroticism. Therefore, SPS may be able to predict depressive tendencies regardless of an individual's level of neuroticism, which is considered a predictor of depression (Nettle, 2006).

Second, emotional coping skills were negatively associated with depressive tendencies only when SPS was high (Figure 2). This result suggests that emotional coping skills play an important role in reducing depressive tendencies among high-SPS university students. Although the mechanism underlying the relationship between SPS and depression is not known (Greven et al., 2019), several studies have examined the factors that may increase depressive tendencies in high-SPS individuals. These findings help us infer the mechanism by which SPS is associated with depression. High-SPS individuals tend to experience more negative emotions than low-SPS individuals (Benham, 2006; Lionetti et al., 2019) due to perceiving various stressors at a lower threshold (Aron & Aron, 1997; Smolewska et al., 2006). Additionally, high-SPS individuals could possess fewer emotional regulation strategies (Brindle et al., 2015), which may link SPS to highly depressive tendencies. The Emotional Coping Skills subscale of the LSSAA assesses factors such as positive thinking and emotional regulation (Kase, Iimura, et al., 2016b). Therefore, although high-SPS university students tend to feel more negative emotions, stronger emotional coping skills may prevent these students from experiencing high depressive tendencies.

Third, decision-making skills were negatively associated with depressive tendencies only when SPS was low (Figure 1). This result suggests that the skills necessary for decision-making play an important role in reducing depressive tendencies among low-SPS students. High-SPS individuals are characterized by a "pause to check" (i.e., a tendency to cautiously check a situation against one's own prior experiences; Aron & Aron, 1997; Smolewska et al., 2006). Conversely, low-SPS individuals often make decisions without using enough caution, which may cause them to display maladaptive behaviors (Aron et al., 2012). Therefore, it could be inferred that high-level decision-making skills enable low-SPS individuals to think logically and critically and to consider the pros and cons of a situation before taking action. Consequently, possessing and implementing these skills may lead them to experience fewer negative emotions, such as depressive mood.

Finally, interpersonal relationship skills were negatively associated with depressive tendencies, without interacting with SPS (Table 2). This result suggests that interpersonal relationship skills play an important role in reducing depressive tendencies among both high- and low-SPS university students. One possible explanation is that interpersonal relationship skills can help individuals acquire social support (Kase, Endo, Iimura, & Oishi, 2013). Therefore, those with higher interpersonal relationship skills, regardless of their SPS levels, may be able to better cope with difficulties in daily life by collaborating with others. However, it should be noted that the effect size of interpersonal relationship skills on depressive tendencies was relatively small ($\beta = -.11$ in the fourth step). Effective communication skills were not significantly associated with depressive tendencies in the regression model (Table 2), while these variables were negatively correlated each other in the correlation analysis ($r = -.31$, 95%CI [−.37, −.25], $p < .001$; see Table 1). This inconsistency may result from controlling for the effects of the other skills in the regression model.

Strengths, Limitations, and Future Directions for Research

This study showed that better interpersonal relationship skills correlated with reduced depressive tendencies in Japanese university students, regardless of their individual levels of SPS. However, it also showed that SPS could still have a moderating effect on the relationship between life skills and depressive tendencies, as

emotional coping skills correlated with improved depressive tendencies in high-SPS individuals, while decision-making skills correlated with reduced depressive tendencies in low-SPS individuals. These results could extend the findings of previous studies that indicate an individual's level of SPS should be considered in the context of developing psychological interventions (Aron et al., 2012; De Villiers et al., 2018; Greven et al., 2019; Pluess, 2015; Takahashi, 2016), and could provide key information for constructing LST programs for university students.

Although these findings are the strengths of our study, several limitations should be acknowledged as well. First, as this study was based on a self-report and cross-sectional approach, it cannot reveal causal relations among the variables, or relationships among the changes in each variable. Future longitudinal studies should investigate such relationships using a cross-lagged effect model (Finkel, 1995) or latent growth model (Duncan, Duncan, & Strycker, 2013). Second, we did not consider some factors related to the variables used in this study. For instance, environmental factors, such as social support, are well known to moderate relationships between SPS and health-related indices (Aron & Aron, 1997; Aron et al., 2005; Pluess 2015; Slagt et al., 2018). Furthermore, sense of coherence is also correlated with each variable used in this study, which can effectively promote and/or improve one's physical and mental health as mentioned above (Evers, Rasche, & Schabracq, 2008; Kase, Ueno, & Oishi, 2016c; Kase et al., 2019; Yano et al., 2019). Thus, future studies should consider these factors to provide more detailed and useful findings that are applicable to practice.

Third, neuroticism, a control variable in the multiple regression analysis, was positively associated with depressive tendencies as largely as SPS (β = .30, 95%CI [.23, .36], $p < .001$ in the fourth step). As mentioned previously, research has verified the differences between SPS and neuroticism (Aron & Aron, 1997; Lionetti et al., 2019; Takahashi, 2016). However, little is known about the differences in the mechanisms underlying the relationships between traits and health-related indices, such as depression. Future studies should examine these differences in order to effectively address mental health challenges among university students.

Finally, although this study treated the HSPS-J19 scores as a continuous variable, these scores may need to be treated as a categorical variable in clinical and/or educational practice. The cut-off scores used in this study for high- or low-SPS individuals were at 1 standard deviation above or below mean scores of HSPS-J19, respectively. A recent study using U.K. samples defined the cut-off scores for high- or low-SPS individuals (Lionetti et al., 2018); however, Greven et al. (2019) pointed out that further taxometric analyses on HSPS should examine whether or not Lionetti et al.'s (2018) findings can be replicated. Additionally, it is unclear that the cut-off scores defined by Lionetti et al. (2018) can be utilized for Japanese individuals. Future work should investigate the cut-off scores of HSPS-J19 and examine the validity of those scores.

Conflict of Interest

The authors declare no conflicts of interest associated with this manuscript.

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Supporting information

Additional Supporting Information may be found in the online version of this article.

Table S1. Descriptive statistics for all variables.
Table S2. Intercorrelations among all variables.
Table S3. Hierarchical multiple regression analysis predicting depressive tendencies.