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Respiratory Sinus Arrhythmia and Depressive Symptoms: Considering the Role of Cultural Orientation and Fit

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Table of Contents

Abstract

The aim of this study was to examine the relationship between cultural orientation, respiratory sinus arrhythmia (RSA), and depression. Horizontal collectivism (HC) has been shown to be predictive of positive psychological adjustment (Oh, 2022; Schermer et al., 2023), but the extent to which the individual's level of HC matches with the group is not well understood. RSA has traditionally been conceptualized as a measure of adaptive functioning; (Graziano & Derefinko, 2013; Qu & Leerkes, 2018, Hinnant et al., 2011) however, more recent research has proposed that RSA is better conceptualized as a marker of susceptibility to environmental influences (Sturge-Apple et al., 2016). In this paper, I examine the extent to which cultural orientation fit may moderate the relations between RSA and depression. Cultural orientation was measured using the Cultural Orientation Scale (Triandis & Gelfland, 1998), while RSA was measured using the Polar H10 band, and depression was measured using the Beck Depression Inventory (Beck, 1996). Regression analyses revealed that RSA was a predictor of lower depression levels when there was cultural fit such that levels of participant horizontal collectivism matched that of the group. These findings contribute to the field of psychology by providing a deeper understanding of the mind-body relationship and the role of culture in mental health outcomes. Further research is necessary to expand upon these findings and to explore the complexities of the relationship between cultural orientation, RSA, and depression.

Keywords: RSA, Culture, Horizontal Collectivism, Cultural Fit Hypothesis, Depression

Introduction

According to the American Psychological Association, “depression is extreme sadness or despair that lasts more than days” (APA, 2023). Data from the National Institute of Mental Health on major depression, which is depression lasting over two weeks, found that in 2020 8.4% of all adults in the U.S., around 21 million individuals, had at minimum one depressive episode that year (NIMH, 2020). College students are known to have one of the highest rates of depression (Furr et al., 2001; Westefeld & Furr, 1987)—and this trend has stayed consistent throughout the years. In a 2022 study with over 350,000 participants across almost 400 campuses, over 60% of students met the criteria for at least one mental health problem and there was a 134.6% percent increase in depression among all college students between the years of 2013 and 2021 (Lipson et al., 2022). Psychological functioning is a byproduct of both individual and social characteristics. Of particular interest to the current paper is cultural orientation, more specifically horizontal collectivism. Collectivism has been shown to be associated with better well-being (Nezlek & Humphrey, 2023). However, the fit between one’s own orientation and that of the larger group is also important to consider. Secondly, RSA, a marker of biological susceptibility, might affect sensitivity to these discrepancies. In the current paper, we examine the main effect of RSA and depression and how cultural fit between one’s own cultural orientation versus the group’s orientation shapes this relationship.

Cultural Orientation

The current understanding of cultural orientation stems from a model from the 1980s created by Dutch researcher Greet Hofstede—who defined four categories that can define a culture: power distance, uncertainty avoidance, individualism-collectivism, and masculinity-femininity (Hofstede, 1980). Among these categories, the dichotomy of individualism-

collectivism has been the most widely researched in the field of psychology and other social sciences. Individuals who belong to collectivist cultures are thought to perceive themselves as a part of a group and prioritize group goals. On the other hand, individuals who belong to individualist cultures are more likely to perceive themselves as independent and prioritize their personal goals. According to Hofstede's theoretical backdrop, Western cultures are often defined as individualistic whereas Eastern cultures are often defined as collectivist (Hofstede et al., 2005).

While initially used to define nations as a whole, current studies have applied cultural dimensions to individuals or groups as well—showcasing that collectivist individuals are more likely to preform citizenship behaviors (Moorman & Blakely, 1995), and individualistic groups are more creative (Goncalo & Staw, 2006). The results go beyond mere behaviors as well—in the United States, states with higher levels of social capital were more individualistic (Allik & Realo, 2004). There are quite a few critiques of Hofstede's model. Some researchers have pointed out that Hofstede's cultural dimensions lack conceptual clarity (Voronov & Singer, 2002), and also equate nation with culture (Baskerville, 2003). Culture and nationality can be quite different, creating a discrepancy in the study of cultural orientation.

In 1995, Triandis and his colleagues proposed a new understanding of cultural orientation that went beyond the mere dichotomy of individualism versus collectivism. This was the measurement of horizontal collectivism (HC), horizontal individualism (HI), vertical collectivism (VC) and vertical individualism (VI) (Triandis et al., 1995). This new framework has been profound in understanding cultural orientations of the self in a way that goes beyond Hofstede's cultural dimensions. According to Triandis, those who identify with vertical collectivism accept that there is inequality and a hierarchy within a collective, but still see

themselves as a part of that collective. Those who identify with vertical individualism also accept that there is inequality, but in contrast see themselves as independent beings. Identifying members of horizontal collectivism both perceive themselves as a member of collective, and perceive equality among all the members in their collective. Finally, horizontal individualists believe in equality among individuals, yet see themselves as independent. According to Triandis, VC, VI, HC, and HI are all distinct cultural orientations that shape how an individual sees the world (Triandis & Gelfland, 1998).

Cultural Orientation and Psychological Adjustment

Cultural orientation has also been shown to be predictive of psychological adjustment. Of particular interest, HC is generally associated with positive mental health outcomes such as resiliency in the face of interpersonal conflict (Oh, 2022). It is even found to predict lower loneliness scores across 19 different countries (Schermer et al., 2023). Horizontal collectivists are more likely to believe in egalitarian ownership, practice an obliging style of conflict management, and believe in equality matching and communal sharing (He et al., 2004; Komarraju et al., 2008; Vodosek, 2009). Additionally, higher levels of HC in men have been associated with lower levels of patriarchal beliefs as well (Yoon et al., 2020). Some studies have shown that HC affects behavior as well, with a particular study showing an indirect association with HC and negative alcohol use (Pilatti et al., 2022).

Conversely, there are scarcity of findings for horizonal individualism. One study found that for students living in an individualistic society (such as the United States), HI is negatively correlated with mental health outcomes such as depression, social anxiety, and obsessive-compulsive disorder (Caldwell-Harris & Aycicegi, 2006). HI has also been shown to have a negative relationship with cyberbullying, especially in comparison to VI (Arpaci et al., 2020).

Horizontal individualists are less likely to associate materialism with success as well, in comparison to vertical individualists (Gabarino et al., 2014).

According to the cultural-fit hypothesis (Ward & Chang, 1997), discrepancies between an individual's cultural values and those of their community can lead to negative outcomes, such as feelings of alienation, depression, and anxiety (Bye et al., 2013). This hypothesis has been supported by research across different cultures and contexts, including studies of international and minority populations (Friedman et al., 2010; Wang et al., 2014). One study showed that job applicants who experienced greater cultural mismatch between themselves and a company were six times less likely to be hired by that company (Bye et al., 2013). Even when put into an environment and given years to adjust to that environment, initial cultural mismatch can have long lasting effects. One study found that first generation students who had initial cultural mismatch still faced psychological and academic costs years later (Phillips et al., 2020). These findings underscore the significance of taking cultural considerations into account in psychological research and practice by indicating that cultural differences can have major effects on people's mental health and well-being.

The relationship between cultural factors such as acculturation, religiosity, ethnicity and depression are prevalent in research, however, there is limited work looking specifically at cultural discrepancy in terms of the measures of vertical/horizontal collectivism/individualism and depression (Lara-Cinisomo et al., 2019; Wong, 2000). Some studies have found that collectivism is tied to decreased levels of depression, with one study finding acculturative stress as a mediator between these two variables (Du et al., 2015). While there is also limited research between these variables, the research that does exist is quite interesting. For example, one study found that video game players with depression who were vertically individualistic displayed

higher disordered gaming behaviors (Lloyd O'Farrell et al., 2022). Another study found that while aggressive humor was related to higher levels of VI, it was also related to lower levels of both horizontal and vertical collectivism (Kazarian & Martin, 2006). A study comparing VC levels between Asian-American and European-American college students found not only that Asian Americans were twice as likely to be aligned with vertical collectivist beliefs, but also that VC was associated with depression only within their racial group (on European Americans, VC had no effect; Dinn & Caldwell-Harris, 2016).

Respiratory Sinus Arrhythmia

HRV is an indicator of the autonomic nervous system (ANS). The ANS is divided into the parasympathetic and sympathetic systems, which regulate the body's ability to relax or respond to tension, respectively. HRV itself is a strong predictor of ANS functionality as it is reflective of the joint effort between both the parasympathetic and sympathetic systems (Singh et al., 2018). While HRV can vary with pathological conditions, in general high levels of resting HRV are associated with positive outcomes that go even beyond the cardiovascular system, such as high performance of the prefrontal cortex (Shaffer & Ginsberg, 2017). On the other hand, low levels of HRV can have the opposite effect—some studies have found that low levels of resting HRV can even predict cardiovascular mortality (Goldenberg et al., 2019).

HRV is closely related to another indicator of cardiovascular health: respiratory sinus arrhythmia (RSA). Fluctuations in heart rate, measured by HRV, often are in sync with respiration—with an increase in heart rate during inspiration and a decrease during expiration (Billman, 2011). The measure of this heart rate variability in conjunction with respiration is referred to as RSA. According to current understandings of RSA, many researchers believe that RSA is an adaptive function of the human body—a concept consistent with Polyvagal theory.

Polyvagal theory "proposes that the evolution of mammalian autonomic nervous system provides the neurophysiological substrates for adaptive behavioral strategies" (Porges 2011). In other words, polyvagal theory suggests that mammals have developed stronger autonomic nervous systems as an evolutionary mechanism. Polyvagal theory also emphasizes the importance of the physiological state; in particular, the physiological state's influence on behavioral and psychological experiences (Porges, 2011). The reasoning behind this is that RSA can actually increase adaptive functions such as compliance, positive behaviors, positive social outcomes, etc. (Graziano & Derefinko, 2013; Qu & Leerkes, 2018, Hinnant et al., 2011). There is a plethora of research on this: low RSA levels are associated with lower ability to regulate responses to negative stimuli and depression (Demaree et al., 2004; Rottenberg et al., 2007), and are shown to strengthen the relationship between rumination and negative interpersonal levels (Caldwell et al., 2022). High levels of RSA, on the other hand, have shown more positive results, such as cardiac recovery after acute social stress (Souza et al., 2007).

Yet, some researchers propose an alternative conceptualization of RSA: as a marker of susceptibility rather than adaptive functioning. The reasoning behind this theory is also rooted in polyvagal theory. Research has shown that, for example, while high vagal tone in high socioeconomic status children increases delayed gratification times, it has the opposite effect in low socioeconomic status children (Sturge-Apple et al., 2016). While high vagal tone is supposed to be a protective measure for all populations (according to the conceptualization or RSA as an adaptive function), it is clear that rather, vagal tone's outcomes on behavior and health are not always consistent across different situations. Other studies have found similar outcomes, such as that high RSA can actually act as a protective buffer in certain situations only, such as in rejection sensitivity among vulnerable populations (Gyurak & Ayduk, 2008).

However, other studies have failed to show this protective buffer effect—such as in diastolic pressure fluctuations (Tan & Taylor, 2010). One of the main aims of this paper is to gain a better understanding of which theory RSA is most in alignment with.

The Relationship Between Depression and Respiratory Sinus Arrhythmia

The relationship between RSA and depression is somewhat already documented in research, but is inconclusive. RSA has been shown to predict depression across various demographic groups (Yaptangco et al., 2015; Yaroslavsky et al., 2014). However, the directionality in levels of RSA predicting depression alone seem to be varied and this data can be inconclusive and weak (Rottenberg et al., 2002, Rottenberg et al., 2007). Thus, considering the proper conceptualization of RSA is essential to better understanding the relationship. For example, one of the studies mentioned above found that while the relationship between RSA and depression itself wasn't clear, higher levels of RSA across time were able to predict non-recovery from depression—which gives a deeper insight into the potential complicated relationship that RSA and depression have (Rottenberg et al., 2002). As mentioned earlier, in some scenarios (where samples may be more vulnerable or susceptible) higher levels of RSA have also been shown to have a protective effect against mental health outcomes. For example: one study found that for individuals that had strong levels of RSA reactivity to a sad film, those individuals were more likely to have a decrease in depressive symptoms over time (Panaite et al., 2016). Another study found that high levels of RSA moderated against the relationship between dyadic coping and depressive symptoms in parents with small children (Switzer et al., 2018).

The Current Study

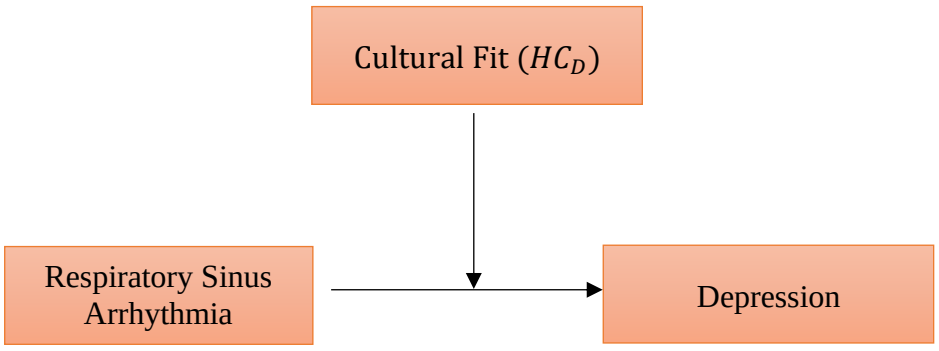
The aim of the current paper is to fill in the gaps of current psychological research that has examined the relationship between depression, cultural orientation discrepancy, and RSA.

Specifically, the aim of this paper is to observe the relationship between RSA and depression, and then understand what role cultural orientation may play in this relationship.

My hypothesis (H_1) is that HC discrepancy (HC_D) will moderate the relationship between RSA and depression such that when there is a high cultural fit (HC levels are similar to HC_D levels for participants), the relationship between RSA and depression will be stronger due to the presence of cultural fit within this relationship (as shown in Figure 1 below). Despite the limited research on the protective effects of RSA within the emerging adult sample, I hypothesize that RSA will act as a protective buffer against depression among the emerging adult sample as they tend to be in environments that elicit susceptibility—as long as they fit into their cultural environments. I believe that these environments are more likely to trigger biological functions aimed at protecting them in some way. Through this research, I hope to build a deeper understanding of the mind-body relationship in human psychology.

Figure 1

Hypothesized (H_1) Moderation



Methods

Participants

Participants (n=116) signed up for laboratory visits on SONA systems as a requirement for introductory psychology courses at a small liberal arts college in Southern California. Of the 116 participants, 35.3% identified as male whereas 64.7% identified as female. The average age of participants was around 20 years old (M = 20.19, SD = 1.24). 42.2% of participants were first-years, 28.4% were second years, 19% were third years, and 10.4% were fourth years or above. 63.8% of participants identified as White, and participants mean familial income was around $150,000.

Materials

The SONA system was used to facilitate sign-ups and academic credit. Questionnaires were administered through Qualtrics forms that participants filled out during the laboratory visit. RSA was measured using the Polar H10 HR monitor, and recorded through the Elite HRV application. Raw HRV data was then converted to csv format on Kubios, combined with other scored data, and finally analyzed in SPSS and R.

Procedure

For the first 87 participants, a full data collection took place in which participants made two separate visits to the laboratory a week apart and also filled out a sleep log in between. Upon arriving, participants filled out an informed consent that explained that the study was completely voluntary and participants could withdraw at any time. Participants then filled out questionnaires regarding their demographics along with various other self-report measures. Biological measures such as height and weight were also measured at this time. RSA was measured at multiple timepoints, and participants participated in various EF tasks. Participants were sent home with a

sleep watch and sleep log, and came back a week later for a follow-up visit. For the final 15 participants, an abbreviated version of the data collection took place for the purpose of this thesis paper. Participants completed an informed consent, reported demographic information and filled out self-report measures, and biological data was recorded. Finally, only baseline RSA was measured. In exchange for participation, students were given SONA system academic credits.

Measures

Cultural Orientation

Cultural Orientation was measured using the Cultural Orientation Scale, a 16-item scale used to measure horizontal and vertical measures of individualism and collectivism (Triandis & Gelfland, 1998). Participants filled out the questionnaire with items in a mixed order as a part of their self-report measures, and responded to statements (e.g., "I'd rather depend on myself than others") on a 9-point scale in which choosing one corresponded to never or definitely no and choosing nine corresponded to always or definitely yes. After data collection, subscales of different measures of cultural orientation (HC, VC, HI, and VI) were calculated such that each subscale received a score out of 36 (HC $\alpha = 0.57$, VC $\alpha = 0.68$, HI $\alpha = 0.58$, VI $\alpha = 064$). Finally, the average of participants' scores were computed in order to calculate an average score of the general sample. This average score was then compared to each individual participant's score to measure the discrepancy between group and individual cultural orientation. Discrepancy was calculated by taking the absolute value of the residuals from regressing each dimension onto biological sex and year in school.

Respiratory Sinus Arrhythmia

Respiratory sinus arrhythmia was measured through the Polar H10 band, which is used to measure heart rate variability. Participants wore the band on their bare skin below their pectoral

muscles, and then watched a meditation video to induce a non-aroused state. Heart rate variability was measured for five minutes through the "Elite HRV" application, and then tagged with each participant ID. The raw files were then exported into Kubios, a heart rate variability software, where the data was cleaned and prepared through the software for analysis. One of these data points available for each of the participants was their high frequency power of their heart rate interval (RRi) series—which Kubios preformed a fast Fourier transformation and logarithmic transformation on for easier analysis. This measure was ultimately utilized as participants' RSA scores, as it provided one of the most accurate and widely-accepted measurements of RSA (Tinanen et al., 2009).

Depression

Depression was measured using the second version of the Beck Depression Inventory (BDI; Beck et al., 1996) with the omittance of item 9 which asks about suicidal thoughts. This question is omitted due to the unavailability of a clinician during the time of administration. Participants filled out the rest of the items on the BDI questionnaire on a scale of 0-3, with 0 indicating low depression (e.g., "I do not feel sad") and 3 indicating high depression (e.g., "I am so sad or unhappy that I can't stand it"). Final values were summed for all 20 items, which resulted in a final BDI score for each participant with higher scores representing severe depression and lower scores representing minimal depression ($\alpha = 0.90$).

Results

Preliminary Analysis

Data cleaning and analyses were performed on RStudio and tables and figures were produced on Microsoft Word. Individual variables (RSA, BDI, HC, HI, VI, and VC) were cleaned and scored prior to data analyses. This included sub-setting data to make two groups—one with variables that had less than 20% of data missing and another with variables with over 20% of data missing. In R, absolute value residuals were created by regressing each of the four cultural orientations onto biological sex and year in school and then utilized as measures for all four measures of respective cultural orientation discrepancies (HC_D, HI_D, VI_D, VC_D) to preform analyses. The two subsets of the data were merged at the end and finally exported into a CSV file.

Descriptives and Correlations

After preliminary analysis, simple descriptive statistics were conducted as displayed in Table 1. All missing data was estimated using FIML in R. I found that on average BDI scores for the sample (M=9.71, SD=8.05) fell in the "minimal" range of depression (Edelstien & Scheck, 2004). Interestingly, the sample scored the highest on horizontal collectivism (M=28.45, SD=4.11), second highest on horizontal individualism (M=27.08, SD=4.84), third highest on vertical collectivism (M=23.90, SD=5.91), and lowest on vertical individualism (M=20.81, SD=5.80). Correlations are also displayed in Table 1. Measures of HC and VC were highly correlated $r(116) = 0.26$, $p < 0.01$, and parental income had a strong positive correlation with VI $r(116) = 0.27$, $p<0.01$, and HC was negatively associated with parental income $r(116) = -0.21$, $p < 0.05$.

Table 1

Means, standard deviations, and correlations with confidence intervals

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. BDI	9.71	8.05							
2. HC	28.45	4.11	-.02 [-.20, .17]						
3. VC	23.90	5.91	-.16 [-.33, .02]	.26** [.08, .42]					
4. HI	27.08	4.84	.06 [-.12, .24]	.00 [-.18, .18]	.14 [-.04, .32]				
5. VI	20.81	5.80	-.20* [-.37, -.02]	-.16 [-.33, .02]	.14 [-.04, .32]	.09 [-.09, .27]			
6. BioSex	0.65	0.48	.25** [.07, .41]	.20* [.02, .37]	-.21* [-.38, -.03]	.09 [-.10, .26]	-.16 [-.33, .02]		
7. Inc	11.86	7.66	-.17 [-.34, .01]	-.21* [-.38, -.03]	.02 [-.16, .21]	.09 [-.09, .27]	.27** [.09, .43]	-.25** [-.41, -.07]	
8. Race_Nonwhite	0.64	0.48	.15 [-.03, .32]	.06 [-.12, .24]	-.08 [-.26, .10]	.06 [-.12, .24]	-.20* [-.37, -.02]	.08 [-.10, .26]	-.15 [-.32, .04]

Note. M and *SD* are used to represent mean and standard deviation, respectively. Biosex is representative of biological sex assigned at birth, Inc of parental income levels, and Race_Nonwhite of individuals that do not identify as White. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). 1 = * indicates $p < .05$. ** indicates $p < .01$.

I then ran partial correlations to understand whether or not each cultural orientation dimension was correlated with depression (while controlling for biological sex and year in school). I found no significant correlations between any of the cultural orientation dimensions and depression, as shown in Table 2.

Table 2

Partial Correlations Between Cultural Orientation Dimensions and BDI

Variable	1	2	3	4	5
1. BDI					
2. HC	-0.08				
3. VC	-0.08	0.33			
4. HI	0.08	-0.04	0.17		
5. VI	-0.14	-0.14	0.13	0.09	

Hypothesis Testing: Regression and Moderation Analyses

Data was first centered and interactions were created to test the proposed models. First, I created a linear regression model (see Table 3) with RSA predicting depression. Regression analyses proved that RSA was in fact a predictor of depression (B = -1.559, $p < 0.01$). Additionally, HC was also a significant predictor of depression within the same main effects model (B = -0.635, $p < 0.05$. Moderation analyses (R^2 = 0.282) revealed that the interaction

between HC_D and RSA (B = 1.138, p < 0.001) significantly moderated the relationship between RSA and depression—proving my hypothesis to be true (H_1). A simple slope plot of this is presented in Figure 2.

Next, I tested all cultural orientations as predictors of depression, and then tested their interaction effects with RSA as predictors of depression. In Table 4, I first ran a linear regression model to observe VC_D as a predictor (R^2 = 0.178). I found that there was no main effect of VC_D on depression within this model. Moderation analyses (R^2 = 0.178) revealed that there was no significant interaction effect with RSA in the relationship either. In Table 5, I ran another linear regression model to observe HI_D as a predictor (R^2 = 0.188). In this model, RSA (B = -1.197, p < 0.05) predicted depression but HI_D did not. As with VC_D , there was neither a main effect or a moderation effect (model R^2 = 0.195) of HI_D. Finally, I ran a linear regression model to observe whether or not VI_D would predict depression in Table 6 (R^2 = 0.175). While there was a main effect of VI_D on depression (B = 4.521, p < 0.001), moderation analyses were insignificant (model R^2 = 0.175).

Finally, analysis was done to observe whether or not the direction of discrepancy of HC (HC_D) had an impact on the moderation model. This was done to confirm the role of cultural fit. In the original analysis absolute values were taken for HC_D values, meaning that directionality was not considered—however, I wanted to see whether or not directionality would change the results. HC_D scores were split up into groups, or in other words made into categorical variables, with higher-than-average HC_D scores (in comparison to the sample average, marked by being in the 84th percentile and higher), average HC_D scores (the middle 50 percent of the sample), and low HC_D scores (16th percentile and below). I found that when the slope of the line of HC_D was

lower than average (B = -1.32, p = 0.25) or higher than average (B = -0.26, p = 0.82), the relationship between RSA and depression was not significant. However, when the slope of the HC_D line was within the average range, the relationship between RSA and depression was significant (B = -2.75, p = 0.01)—highlighting that RSA is protective against depression for those who have a strong fit with the level of horizontal collectivism in their community. The effects are observed in Figure 3.

Table 3

Hypothesized Moderation Model Results Predicting Depression

Variable	*B*	*SE B*	β	R^2
Model 1				0.166
(Intercept)	10.081	2.938		
Sex	3.077	1.494	3.077*	
Age	-0.434	0.552	-0.434	
Race	1.917	1.466	1.917	
Income	-0.003	0.113	-0.003	
HC_D	-0.635	0.291	-0.635*	
RSA	-1.559	0.598	-1.559**	
Model 2				0.282
(Intercept)	14.729	3.068		
Sex	3.430	1.406	3.430*	
Age	-1.100	0.543	-1.100*	
Race	0.664	1.427	0.664	
Income	-0.116	0.133	-0.116	
HC_D	-0.810	0.278	-0.810**	
RSA	-5.434	1.094	-5.434***	
RSAxHC	1.138	0.281	1.138***	

Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, HC_D = Horizontal Collectivism Residuals (Discrepancy), RSAxHC = Interaction between RSA and HC_D; *p < .05, **p < .01, ***p < .001.

Table 4

Vertical Collectivism Moderation Model Results

Variable	*B*	*SE B*	β	R^2
Model 1				0.178
(Intercept)	7.544	2.959		
Sex	-0.227	0.105	-0.227*	
Age	1.009	0.304	1.009**	
Race	-0.308	0.107	-0.308**	
Income	5.778	1.721	5.778**	
VC_D	-0.287	0.749	-0.287	
RSA	0.054	0.324	0.054	
Model 2				0.178
(Intercept)	7.448	2.998		
Sex	2.922	1.494	2.922	
Age	0.112	0.559	0.112	
Race	0.899	1.486	0.899	
Income	0.016	0.116	0.016	
VC_D	-0.133	0.203	-0.133	
RSA	-1.109	1.197	-1.109	
RSAxVC	-0.039	0.196	-0.039	

Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, VC_D= Vertical Collectivism Residuals (Discrepancy), RSAxVC = Interaction between RSA and VC_D; *p < .05, **p < .01, ***p < .001.

Table 5

Horizontal Individualism Moderation Model Results

Variable	*B*	*SE B*	β	R^2
Model 1				0.188
(Intercept)	8.024	2.860		
Sex	2.914	1.481	2.914*	
Age	0.079	0.550	0.079	
Race	1.360	1.496	1.360	
Income	0.020	0.113	0.020	
HI_D	-0.361	0.251	-0.361	
RSA	-1.197	0.583	-1.197*	
Model 2				0.195
(Intercept)	7.861	2.861		
Sex	3.056	1.484	3.056*	
Age	0.093	0.548	0.093	
Race	1.377	1.491	1.377	
Income	0.017	0.114	0.017	
HI_D	-0.328	0.252	-0.328	
RSA	-0.591	0.871	-0.591	
RSAxHI	-0.204	0.218	-0.204	

Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, HI_D= Horizontal Individualism Residuals (Discrepancy), RSAxHI = Interaction between RSA and HI_D; *p < .05, **p < .01, ***p < .001.

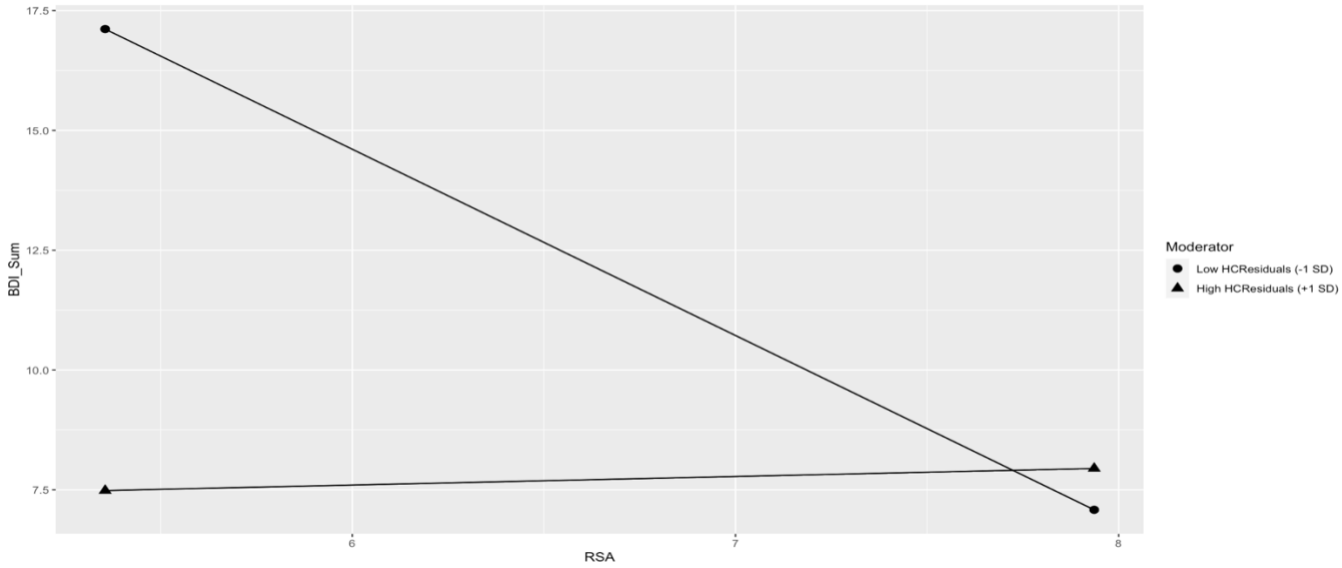
Table 6

Vertical Individualism Moderation Model Results

Variable	*B*	*SE B*	β	R^2
Model 1				0.175
(Intercept)	7.313	3.019		
Sex	0.647	0.044	0.647***	
Age	3.267	0.125	3.267***	
Race	0.638	0.045	0.638***	
Income	11.862	0.708	11.862***	
VI_D	4.521	0.311	4.521***	
RSA	0.114	0.169	0.114	
Model 2				0.175
(Intercept)	7.377	3.030		
Sex	2.825	1.496	2.825	
Age	0.090	0.558	0.090	
Race	0.920	1.488	0.920	
Income	0.017	0.115	0.017	
VI_D	-0.092	0.208	-0.092	
RSA	-1.533	1.015	-1.533	
RSAxVI	0.040	0.161	0.040	

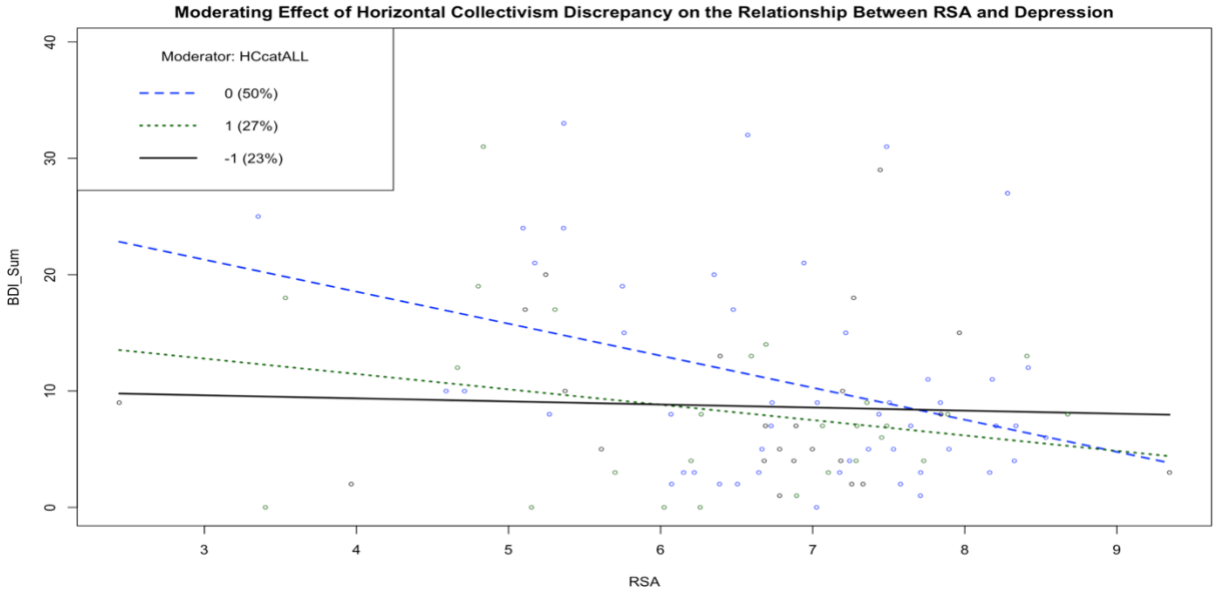
Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, VI_D = Vertical Individualism Residuals (Discrepancy), RSAxVI = Interaction between RSA and VI_D; *p < .05, **p < .01, ***p < .001.

Figure 2



Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, BDI_Sum = Depression

Figure 3



Note. All variables were centered; RSA = Respiratory Sinus Arrhythmia, BDI_Sum = Depression, HCcatALL = Horizontal Collectivism Discrepancy

Discussion

The aim of this study was to delve deeper into dimensions of cultural orientation discrepancy, RSA, and depression. Despite the limited literature surrounding RSA as a marker of susceptibility (Sturge-Apple, 2016), the results indicate that RSA is not just a one-size-fits-all adaptive function, but rather is in fact, a measure of susceptibility. Results showcased that RSA was in fact a predictor of lower depression levels when there is horizontal collectivism cultural fit. This finding does not come as a surprise, given the positive mental health outcomes already found to be associated with a horizontal collectivist orientation (Oh, 2022; Schermer et al., 2023; Pilatti et al., 2022).

The final analyses revealed that it was actually those who fit the context of their environment most closely that high levels of RSA behaved a protective mechanism against depression. While one cannot definitively say why this is the case, it can be inferred why this may be. Perhaps those who fit the environment around them are more likely to be susceptible to environmental stressors because they are so culturally aligned with the environment around them, which is why RSA can act as such a strong protective buffer for that group. On the other hand, for groups that deviate from the dominant cultural beliefs of their environment, they may be less susceptible to the stressors that are present in that environment. While different from cultural orientation, similar patterns have been apparent in the research on belonging, showcasing that those who feel that they belong with their environment are more likely to feel worse after facing discrimination (Huynh & Gillen-O'Neel, 2016; Hussain & Jones, 2021).

In terms of the other cultural orientations (HI_D, VC_D, VI_D), there were also some interesting outcomes worth considering. While VI_D did have a main negative effect on depression, the proposed interaction model was insignificant. Prior research has shown that VI

orientation is more present in individuals that are at lower risk of depression such as men or European Americans, which may explain why that type of orientation is also likely to predict lower levels of depression (Tehrani &Yamini, 2022; Vargas & Kemmelmeir, 2013). For VC_D, prior literature on the relationship between VC and mental health outcomes was quite limited, so the lack of a main or interaction effect between VC and depression is consistent with literature. Finally, even though there was already limited literature on the construct of HI, there was some literature that highlighted a negative relationship between HI and mental health outcomes (Caldwell-Harris & Aycicegi, 2006). While not significant, the results indicated a similar outcome with higher levels of HI_D showing a weak negative relationship with depression levels.

All in all, the results not only affirm findings of current literature, but build on them. Through this study, I have been able to affirm that there are differences in cultural orientation even in small samples, and that these orientations have a profound effect on mental health outcomes. The findings reveal the positive outcomes that horizontal collectivism can potentially have on depression, given that there is cultural fit. Horizontal collectivists with high cultural fit not only see themselves as a part of a community, but also acknowledge that they are equals within the communities they are a part of (Triandis et al., 1995). In this case, it is possible that individuals with a horizontal collectivist orientation are better equipped to deal with mental health issues due to their perception of community and in-group identity and thus have lower rates of depression. This pattern has actually been observed in research settings where in-group settings were assigned (Ip et al., 2021; Dodding et al., 2008). Living in a country with one of the highest individualism rates in the world (Braje et al., 2019), it is imperative to consider how horizontal collectivism as an orientation may be useful in decreasing negative mental health outcomes.

Additionally, I was able to confirm that in this study, RSA was in fact a measure of susceptibility rather than adaptive functioning. The implications of these findings go beyond the mere study of psychology. RSA could be used as a preventative screening measure to test for susceptibility to potential mental health outcomes such as depression. This is important as RSA is a relatively easy measurement, compared to other markers of susceptibility such as mammographic density as a marker of susceptibility to breast cancer or neuroimaging as a marker of susceptibility to psychosis (Boyd et al., 2001; Andreou & Borgwardt 2020). This is also important because there are limited physiological measures that can detect susceptibility to depression—which is unfortunate as physiological measures are the most objective and reliable measures that can be recorded. Overall, I hope that the findings of this research are not only able to contribute to the literature on RSA, cultural orientation discrepancy, and depression, but are also able to inspire new research to build open these findings.

Strengths and Limitations of the Current Study and Future Directions

As stated in the earlier section, this study had some strengths—for example, being in an environment that not only included a plethora of stressors, but also a sample size with a diverse background. Some other strengths of the study include the consistency of the study with past literature, as well as consistency of the data with past literature. On the other hand, there were quite a few limitations of the study. First, there are some limitations with the methodology and data collection. Since the data was collected on a small college campus, it was difficult to ensure that research assistants that collected the data did not know or had never seen their participant, although they were trained to collect data from each participant in the same way. This may have not only impacted the participant's self-report measures, but also their heart rate. Since RSA was measured with the polar band as well, there may have been a possibility for either participant or

research assistant error. Additionally, the sample size was only *n*=116, and a higher sample size would be more ideal in increasing the statistical power since this was a study with an interaction effect. Furthermore, there were limitations with the data. Unexpectedly, there was actually quite a low score on the depression scale for the sample, meaning that the sample reported mostly minimal depression scores. This may have impacted the outcomes, as results may be different in samples where depression scores are higher.

In the future, research should focus on collecting other measures of mental health—such as anxiety, loneliness, or PTSD to observe whether or not RSA can also indicate susceptibility for these other measures. Additionally, research should focus on including more diverse and marginalized groups—not only because they are the most underrepresented in research, but also because they may actually be the most susceptible to their environments. Thus, increasing research with them as participants may be the first step in fixing systemic inequalities to help people susceptible to potential negative outcomes get the care that they need. Finally, an increase in studies that measure other physiological markers beyond RSA is encouraged—to observe whether or not they have similar or different effects. Overall, the goal of future research should be to test RSA and other physiological measures as markers of susceptibility through the recommendations provided above—as well as to expand literature on the cultural fit hypothesis.

Conclusion

In conclusion, this paper explored the relationship between cultural orientation, respiratory sinus arrhythmia (RSA), and depression. The goal of examining the role of cultural fit in the relationship between RSA and depression and to fill gaps in the current literature on these variables was achieved. The results of the study revealed that at high levels of cultural fit, RSA acted as a protective buffer against depression. This finding suggests that RSA may be a measure of susceptibility rather than a one-size-fits-all adaptive function. The study also provided interesting insights into the relationship between other cultural orientations and depression. The findings of this study contribute to the field of psychology by providing a deeper understanding of the mind-body relationship and the role of culture in mental health outcomes. Further research is necessary to expand upon these findings and to explore the complexities of the relationship between cultural orientation discrepancy, RSA, and depression.

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