

CES-D MEASUREMENT STABILITY ACROSS INDIVIDUALISTIC AND
COLLECTIVISTIC CULTURES

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By
Yanyan Fu

Director: Dr. Leonardo Bobadilla
Committee Members: Dr. Jamie Vaske
Dr. David McCord

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ABSTRACT

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Yanyan Fu, M.A.

Western Carolina University (May 2013)

Director: Dr. Leonardo Bobadilla

The purpose of this study was to analyze the cross-cultural and cross-time measurement invariance of Center for Epidemiological Studies Depression Scale (CES-D). The research data that were collected in 1994-1995 and 1996 respectively were from the National Longitudinal Study of Adolescent Health (Add Health). There were two steps that were used for analyzing the measurement invariance. First, Exploratory Factor Analysis (EFA) was used to analyze the dimension invariance (factor structure) for the Asian American and European American adolescents across two waves. Three-factor model was established for both groups across two waves. Second, Confirmatory Factor Analysis (CFA) was used to check the factor loading and threshold invariance of the items that were dimension invariant. The results showed that the 13-item three-factor CES-D was measurement invariant across the groups and across time. Nevertheless, new sample should be collected in order to implement the new 13 items as a depression screening method across groups.

INTRODUCTION

Psychological disorders such as obsessive compulsive disorder (OCD), schizophrenia, and depression vary in their rates and symptomology across cultures (Gross & Levenson, 1993; Teggim, Elk, Ben-Arie, & Gills, 1985; Yorulmaz, Gençöz & Woody, 2010). A reason for these differences may be the varying perception of the self and interpersonal relationship across cultures (Heine, Lehman, Markus, & Kitayama, 1999). One of the main factors that contribute to differences in perception of self with regard to others across cultures is collectivistic and individualistic perspectives. Individualism means that individuals will prioritize self-interest over group-interest, while collectivism means prioritizing group-interest over self-interest (Triandis, 1988). In general, the United States and British influenced countries are individualistic, while East Asian countries and some African countries are collectivistic (Inkeles, 1983).

The dimension of collectivism-individualism may help explain differences in variation of psychological disorders such as depression across cultures (Heine et al., 1999). For example, collectivistic cultures emphasize a more somatic form of depressive symptoms compared to the individualistic cultures (Zhang, 1995). By extension, differences between collectivistic and individualistic perspectives extend to the measurement of depression. Importantly, many studies have found that the commonly-used four-factor structure (positive affect, negative affect, interpersonal and somatic) of Center for Epidemiologic Studies Depression Scale (CES-D) developed by Radloff (1977), may not be universally applied. Studies showed that the four-factor CES-D model did not fit Asian samples which are highly influenced by collectivistic values (Jang, Kwag, & Chiriboga, 2010; Kuo, 1984). The methods used by previous researchers are

replicated in this study, and the aim of the study is to check whether the CES-D is applicable for Asian American teenager sample across time.

LITERATURE REVIEW

Culture is the collection of ideas, attitudes, values and traditions shared by a group of people, and transmitted from one generation to another (Brislin, 1988). The major elements of a culture that affect an individual are the period of time and places in which the person lives, the language he or she speaks, and the norms, values and habits that surround the person (Triandis, 1994; 2001). Due to the pervasive nature of culture, it has been proposed that the relationship between culture and society is similar to the one between memory and individuals (Kluckohn, 1954). Consciously and subconsciously, culture influences the way people behave on a daily basis, and contributes to their traits and behaviors.

Increasingly, different cultures cohabit side by side, with more people involved in cross-cultural activities that influence each other. However, despite increased interaction, different cultures still have varying values, norms, and customs, and ways in which they interact and perceive others. For example, a study by Al-Zahrani and Kaplowits (1993) found that Saudis tend to treat members of out-group with less respect than Americans. They also found that Americans tended to attribute the behaviors of others to internal causes (e.g., personality characteristics, emotion), whereas Saudis tended to attribute others' behaviors to external causes (e.g., social system, economic circumstances). Moreover, people from different cultures may even differ in personality traits. For example, a study by De Raad et al. (2010) found that only 3 factors (Extraversion, Agreeableness and Conscientiousness) from the Big Five model of personality are applicable to samples from 13 European countries and Korea.

The above findings suggest that certain traits may not be universal and in particular there may be marked differences between Western and Asian cultures. Cross-cultural psychologists have suggested that culture itself may help explain these differences. Humans are social beings and therefore feel pressure to fit in the social roles in the cultural context in order to function normally. For example, if one culture values collaboration between members the trait of Agreeableness may be more prevalent than that another culture that values independence of individuals.

Similarly, psychological disorders can be also influenced by different cultural contexts. Psychological disorders refer to deviant behaviors, mental disabilities or conditions that significantly increase the risk of death or disability within a given culture (American Psychiatric Association[APA], 2000). Since social roles vary in different cultural contexts, the classifications of normal behaviors also vary. Therefore, the definition and boundaries of the abnormal behaviors can vary due to the differences in norms, values, and attitudes across cultures.

Cross cultural manifestation of psychological disorders

The Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV-TR, APA, 2000) lists several psychological disorders that only manifest themselves in certain cultures or countries. For example, shenjing shuairuo is a psychological disorder characterized by dizziness, insomnia, and fatigue, and often diagnosed in Chinese and Japanese culture. This culture-bound syndrome resembles a combined manifestation of mood and anxiety disorders observed in Western cultures, but it is diagnosed as a single disorder in the majority of areas in China (Chinese Classification of Mental Disorders- 3,

2001). Thus, there are psychological disorders that may be completely unique to certain cultures.

There are also many psychological disorders that are present across different cultures, but vary in the presentation of their symptoms. For example, obsessive-compulsive disorder (OCD) which is characterized by compulsive behaviors (e.g., excessive hand washing, ordering) and persistent thoughts that significantly disturb the person's normal life (e.g., consistently worrying about whether a door is unlocked, APA, 2000), has been found to vary in cross cultural comparisons. A study by Yorulmaz et al. (2010) administered 3 inventories to a sample of Turkish and Canadian non-clinical participants: 1) the Thought Control Questionnaire (Wells & Davies, 1994), which measures ways in which persons control their thoughts such as distraction, worry, punishment, and reappraisal; 2) the revised version of the White Bear Suppression Inventory (Wegner & Zanakos, 1994), which measures people's thought suppression behavior; and 3) the Padua Inventory (Burns, Keortge, Formea, & Sternberger, 1996) which measures OCD symptoms such as checking, and compulsive hand washing. The results showed that the mean levels of the worry and thought suppression used by Turkish participants were significantly higher than those of Canadian participants, whereas Canadian participants tended to have a higher mean levels of self-punishment behavior (e.g., nail biting) than Turkish participants (Yorulmaz et al., 2010). Therefore, even though the same psychological disorder exists in different cultures, the symptoms of this disorder can vary across cultures.

Another example can be seen in the variation of schizophrenia, which is a disorder characterized by delusions (e.g., persons feel and believe they are being

monitored or controlled by outside entity), hallucinations (e.g., frequently hearing words that no one else can hear) and disorganized speech (APA, 2000). Various studies indicate that schizophrenia differs across cultures, and others suggest that schizophrenia may not be a universal disorder (Thakker & Ward, 1998). For example, a study by the World Health Organization (WHO) of 1379 people with psychotic symptoms sampled from non-westernized developing and westernized developed countries, showed that the mean level of severity of schizophrenia symptoms was lower for patients in developing countries compared to those in developed countries (Sartorius et al., 1986). Another study comparing the symptoms of schizophrenia between African and Indian patients found that on average, the African patients tended to have more depressive symptoms and olfactory hallucinations than Indian patients, whereas the mean levels of auditory hallucinations were higher for Indian patients (Teggin, Elk, Ben-Arie, & Gills, 1985).

In addition to the differences in mean levels of schizophrenia symptoms across cultures, the factors that trigger the onset of schizophrenia also differ across cultures. One study examined the number of stressful life events (e.g., relocation, health problems) that occurred prior to the onset of schizophrenia in 386 patients across nine different developing and developed countries (Day et al., 1987). Most of the locations in developed countries were highly Westernized such as Rochester in the United States and Camberwell in the United Kingdom; by comparison, locations in developing countries, such as Agra in India, were not heavily influenced by Western civilization. Results of the study showed that the onset of schizophrenia was more likely to be associated with stressful events in non-Westernized countries relative to Westernized countries (Day et al., 1987). In summary, the aforementioned studies suggest that culture can influence the

variation of psychological disorders. As such, significant amounts of research efforts have been aimed at determining what cultural factors influence the variation of psychopathology.

Individualistic-collectivistic influence on psychological functioning

One important factor that has been suggested as an important influence in the differential manifestation of psychological disorders across cultures is the individualism and collectivism dimension. Individualism means ranking individual interests over the group's interests, whereas collectivism means ranking the group's interests over individual interests (Triandis, 1988). Countries like the United States, and Great Britain, are highly individualistic. On the other hand, many African countries and East Asian countries such as China, Japan, and Vietnam are highly collectivistic (Inkeles, 1983).

A study by Hui and Triandis (1986) compared individualism and collectivism from several aspects and arrived at the following main conclusions regarding the two cultural approaches: 1) individualists are concerned about their own decisions, whereas collectivists are more concerned about others' decisions; 2) individualists value independence whereas collectivists value social connection; 3) individualists are less dependent on the groups they belong, while collectivists are very dependent on the groups, and would drop from it (i.e., breaking with family) only if the groups became highly harmful to groups members; 4) collectivists engage in more face management (i.e., present own behavior and manner in a socially desirable way), whereas individualists do less face management; and 5) individualists think they are separated from others, while collectivists think they are bonded to one another, even involved in others' lives (Hui & Triandis, 1986).

The aforementioned aspects of individualism and collectivism have been proposed to account for many differences in the behaviors related to psychopathology between cultures. For example, a study by Forbes et al. (2009) compared indirect aggressive behaviors (e.g., spreading rumors, ignoring, manipulating other's guilt) to direct aggressive behavior (e.g., pushing, and hitting) differences among Chinese (collectivistic), American (individualistic), and Polish (both individualistic and collectivistic) college students. The results showed that Chinese college students' mean levels of direct aggressive behaviors were lower compared to Americans and Polish college students. According to the researchers, differences in aggressive behavior among the 3 cultures may be due to the different value given to social cohesion and interpersonal face management in each culture. Among collectivistic cultures, more than individualistic cultures, social cohesion and interpersonal face management are highly valued adaptive behaviors, and anyone who does not follow the norm (e.g., by being directly aggressive) would be discredited and bear the risk of being abandoned by those around them (Forbes et al., 2009).

The influence of collectivism and individualism extends to depression, which is one of the most common psychological disorders in the world (WHO, 2012). Depression is characterized by loss of interest in daily activities, fatigue, insomnia, and repeated thoughts of death, which can lead to suicide (APA, 2000). Although depression is present worldwide, its rates vary across different cultures. For example, according to a report by macmillan (2011), the depression rate in the United States was 19.2%, while in China it was 6.5%. These differences are striking, and one possibility for the observed differences is that depressive symptoms vary differently across individualistic and

collectivistic cultures. For example, as alluded earlier, somatic forms of depressive symptoms (e.g., loss of appetite, insomnia or hypersomnia) are more often reported in countries like China but less so in Westernized, individualistic countries (Zhang, 1995). Given that expressing direct negative feelings can destroy the social harmony in collectivistic cultures, somatic forms of depressive symptoms may be more acceptable in a collectivistic culture since the direct negative feelings (e.g., anger, depression) are repressed (Al-Issa, 1990; Chen, 1995). Thus, various studies suggest that psychological well-being differs between individualistic and collectivistic cultures, and that these differences also affect depression.

Individualistic-collectivistic influence on the variability of depression

Given the marked differences between individualistic and collectivistic cultures in the expression of depression, significant research efforts have attempted to determine how internal factors (i.e., person-centered), interact with external factors (e.g., cultural norms) across cultures to affect the rates and expression of depression.

Among some of the person centered factors studied that affect depression across cultures is positive self-regard which is considered an important index of subjective well-being (Taylor & Brown, 1988). Self-identity is not emphasized in collectivistic cultures; by comparison, in individualistic cultures self-identity and positive self-regard is highly valued. The concept of self-regard, contains aspects of independence (how able is an individual to live an independent life) and locus of control (e.g., how able is an individual to control his own behaviors). It has been developed by Western philosophers, and it originates from an individualistic perspective (Heine et al., 1999). In American culture, self-confidence is highly regarded and considered a positive aspect of well-being, while

negative self-regard is associated with depression (Kernis, Grannemann, & Mathis, 1991; Nakane, 1970). In contrast, this is not the case in collectivistic countries like Japan where the concept of self is not emphasized. In fact, the Japanese words for self-confidence (jishin) and self-respect (jisonshin) have negative connotations and whoever feels confident is considered arrogant and distant from others (Heine et al., 1999, although this may not be the case in all collectivistic cultures, see Cai, Wu & Brown, 2009). In short, constructs related to depression like self-regard vary across individualistic and collectivistic cultures, and appear to influence the expression of depression among them.

Along the same lines, a study by Soto et al. (2011) compared the relationship between expressive suppression (suppressing emotional thoughts when emotion is aroused, Gross & Levenson, 1993), and depressive levels between Chinese college students from Hong Kong and European American college students in the United States. The results indicated that suppressing the expression of feelings was not associated with negative functioning in Chinese students, while expression suppression was associated with high depression among European American students. Soto et al. (2011) concluded that among Chinese students the expression of negative feelings may disturb group harmony and their positive impression which are considered equally important norms by Chinese culture. Therefore, given that Chinese students are generally comfortable not expressing their feelings, expression suppression did not appear to affect the Chinese students' psychological functioning relative to European Americans.

The above-mentioned study by Soto et al., (2011) is particularly interesting because it is also emblematic of an increasing world-wide tendency for cultural interconnectedness. From 1898, until 1997, Hong Kong was a British Colony and thus

influenced by British individualistic culture, but traditionally it has been a collectivistic Chinese culture. Therefore, Hong-Kong could represent a microcosm of future societies in which individualistic and collectivistic values coexist and influence each other. Indeed, as the world becomes more interconnected and globalized, it is increasingly common for persons of one culture to be immersed into another either by cultural takeover or patterns of immigration.

These trends are particularly true in the United States which historically has had high immigration rates and has been a “melting pot” for people from different cultural backgrounds, but by and large maintains a European-influenced individualistic cultural norm. However, this may be changing. According to the 2010 census, Asian Americans were 4.8 percent of American population and their population is rapidly increasing. Asians now surpass Hispanics as the largest immigrant group and are having an outsized influence in the cultural and economic environment (Semple, 2012). Therefore, it is important to understand how individualistic and collectivistic cultural factors influence depression, especially in countries with high immigrant rates like the United States, in order to better understand and treat this disorder in people who will likely be influenced by both cultures rather than one.

Influence of acculturation on Depression

As previously mentioned, in the United States, individualism is the mainstream and dominant culture. While Asian Americans will often adhere to the values of their original culture (i.e., collectivism), this does not mean that there is no assimilation (Kim, Atkinson, & Umenmto, 2001). The process of assimilation into a culture is called acculturation, and the willingness to acculturate and the lifestyle that a person lives

determines their acculturation level (Berry & Kim, 1988). For example, people who immigrate at a relatively young age are more easily acculturated than individuals who immigrate later in life (Cheung, Chudek, & Heine, 2011).

In general, acculturation is important to understand because it provides an index of an individual's internalization of the surrounding culture, such as the adoption of individualistic or collectivistic values. Importantly, as it refers to the understanding of psychological disorders, acculturation has been shown to influence psychological constructs like self-esteem which are related to psychopathology including depression. For example, Heine and Lehman (1997) gave Japanese international students a self-esteem questionnaire when they visited Canada. Seven months later, the same questionnaire was given to the Japanese students again, and the results showed that their self-esteem increased significantly. On the other hand, the same questionnaire was given to Canadian teachers in Japan on the first day of arrival and then 7 months later. The study showed that the mean levels of Canadian teachers' self-esteem decreased significantly at the 7 month follow-up. Additionally, the Japanese students who assimilated into Canadian culture reported greater mean level of self-esteem increases than those who chose to keep their own culture (Heine & Lehman, 1997). The study suggests that acculturation to individualistic cultures is significantly correlated with changes in people's perception of themselves and, since self-esteem is associated with depression, acculturation could affect depression (Orth et al., 2008).

Studies examining the influence of acculturation have found that there is a discrepancy in the rates of depression between Asian Americans who are acculturated and European Americans. A study by Young, Fang, and Zisook (2010) found that Asian

American college students at the University of San Diego had significantly higher mean levels of depression than their European American counterparts. Researchers have suggested two reasons that may cause Asian-American students to be more likely to suffer higher levels of depression. The first is an inner conflict between the modern Western values in which they live, and traditional, collectivistic Eastern values held by their parents. The second reason is that Asian parents can be very strict with their children, and Asian children usually experience more academic pressure compared to other ethnic groups which could make people more susceptible to depression (Hovey et al., 2006). These two reasons indicate that collectivistic values could have a negative impact on Asian Americans' mental health.

Similarly, the other collectivistic values could increase the prevalence of depression in an individualistic culture. A study about help-seeking and coping strategies conducted with 2,678 college freshmen students (77% White American, 13% Asian American, and 10% African American) in a Mid-Atlantic university showed that the mean levels of using avoidance to deal with problems were higher in the Asian American group compared to European American and African American college students (Sheu & Sedlacek, 2004). Avoidance coping strategies may prevail in Asian Americans due to their original collectivistic culture where avoiding conflict is considered to facilitate social cohesion. However, other studies have shown that avoidance coping strategies are correlated with depression among Asian Americans (Chang, 1996; Iwamoto, Liao, & Liu, 2010).

Altogether, the above studies suggest that Asian Americans are still under the influence of their original collectivistic values. Notably, the tension between internalizing

and externalizing values and level of acculturation could contribute to systematic differences in the patterns of response between Asian Americans and European Americans in depression questionnaires. One way to understand how different cultural values influence differences in a depression scale between ethnic groups is by determining if there is “measurement invariance” between them. Measurement invariance is a statistical method that is used to check whether a scale can measure the same aspects under different operational circumstances (Horn & mcardle, 1992), it can be used as a systematic tool for identifying the perception difference or bias for a depression scale across different ethnic groups. It can distinguish the response pattern and perception differences in a depression scale from the differences in the mean level of depression across groups.

Measurement Invariance

Self-report is a commonly used form of measurement in psychological studies. However, the same measure may yield different results when used on persons from different backgrounds (Gregorich, 2006). For instance, in the previously summarized study comparing OCD symptoms between Turkish and Canadian participants (Yorulmaz et al., 2010), recall that the level of Turkish participants’ thought suppression (e.g., distraction, worry, and reappraisal) was higher than that of Canadian participants. One possibility is that the Turkish participants indeed experience more worry than Canadian participants. However another possibility is that the question in the measure may be interpreted differently by one group compared to the other. Therefore, it is important to know how a measurement is interpreted and perceived by diverse groups before uniformly applying it to other groups.

One of the ways to analyze the applicability of a measure is through measurement invariance. Measurement invariance is a systematic and statistical method that can be used to analyze the reliability and validity of a measurement across different groups. There are usually 4 steps of examining measurement invariance across two groups. The first step is to analyze the dimensional invariance in which the number of factors of each group is compared. In this step, separate exploratory factor analyses (EFA) for the two groups are used to extract the number of factors that capture the construct of interest. Maintaining the same number of factors for both groups is the first prerequisite for measurement invariance (Gregorich, 2006).

The second step is to analyze configural invariance across groups. The goal of this step is to determine whether the same indicators represent the latent construct for both groups (e.g. Self-report items, behavior observation ratings). For instance, the aforementioned study by Soto et al. (2011) showed that suppressing the expression of feelings was not associated with negative functioning in Chinese students while expressive suppression was associated with high depression among European American students. Therefore, the suppression of feelings may not be a good correlate of the depression level of Chinese students, while it is associated European American depression levels. These differences could contribute to lack of configural invariance across collectivistic and individualistic cultures. If on the other hand, the configural invariance is met, the second prerequisite of measurement invariance is completed and the next step of analysis can proceed (Gregorich, 2006).

The third step is to analyze the metric invariance which requires the factor loadings to be equal across groups (Gregorich, 2006). This step requires confirmatory

factor analysis (CFA) to test whether one unit change of factors corresponds to the equal amount of change for the indicators for both groups. If the amount of change for the indicators is significantly different across groups, the measurement is not invariant. The different relationship between factors and corresponding indicators across two groups means that the items have different meanings across two groups. In other words, the response of certain item may have different patterns: one group may respond the items with centralized answers while the other group may respond the items with relatively widely ranged answers. For example, collectivists may respond the questions in a centralized manner and may be less likely to choose extreme answers because they tend to do face management, and unconsciously engage behaviors desired by society (Hui & Triandis, 1986). On the other hand, individualistic people may respond to the question scatteredly since face management is not emphasized in the culture (Hui & Triandis, 1986).

The fourth and last step is to analyze the intercept/threshold (an index that determines whether the model is invariant across groups) invariance using CFA (Gregorich, 2006). If the intercepts/thresholds of the items are different across groups, there may be a systematic bias towards the items and the average response of one group may be higher than that of the other. For example, as previously mentioned, collectivists may perceive positive self-regard differently relative to individualists, since some collectivistic culture may view positive self-regard with negative connotations (Heine et al, 1999). Therefore, collectivists may tend to rate less extreme responses such as “extremely positive”, in measures of self-regard and therefore their responses have less variation compared to individualists’, resulting in metric invariance.

Center for Epidemiologic Studies Depression Scale (CES-D) development

Depression has always been a major concern worldwide. One of the most common screening methods is the Center for Epidemiologic Studies Depression Scale (CES-D) questionnaire (Seeley, Lewinsohn, Roberts, & Allen, 1997). The CES-D contains 20 items to measure the symptoms of depression, and it has a good reliability in both clinical and community samples (Zimmerman & Coryell, 1994). In the process of studying CES-D for decades, the items of CES-D have been researched and modified by many researchers. For instance, a item related to suicidal ideation (life worth living) was added into the CES-D questionnaire because it was considered as a very important predictor of depression (Garrison, Lewinsohn, Martseller, & Langhinrichsen, 1991). Usually, when using CES-D for clinical practice, the common cut-off score is 16, which indicates that whoever scores 16 or above needs to consider further depression diagnosis or treatment (Weissman et al., 1977).

Cross cultural applicability of CES-D scale

Many studies have shown that the CES-D is usually a four-factor model structure (negative affect, positive affect, somatic, and interpersonal factors). However, subsequent studies have shown that the four-factor model did not apply to Asian Americans well. For example, Kuo (1984) found that the negative affect factor and the somatic affect factor bonded together for Asian Americans. A meta-analysis by Kim, decoster, Huang, and Chiriboga (2011) examined the CES-D across different ethnic groups using EFA and CFA. The results suggest that the depressed affect factor, positive affect factor, and somatic symptom factors are very consistent across African American, Native American, European American, and Hispanic American groups, but the interpersonal factor does not

apply to Asian Americans. The item “I feel as good as others” item is included in the interpersonal factor for Asians, while it is included in the positive factor for other ethnic groups. This variation may be due to cultural differences in the perception of interpersonal relationships. In a collectivistic culture, group cohesion and group harmony/happiness is considered an important norm (Heine et al., 1999). The social aspects of a person are sometimes more highly emphasized than the individual aspects. Thus, the “I feel as good as others” item may be perceived as an interpersonal relationship question rather than a personal mental health question for collectivists, whereas for individualists they may perceive the “as good as others” item as a question that asks about mental state.

Another study by Jang, Kwag, and Chiriboga (2010) used the CES-D to test cultural differences in the expression of depression symptoms between Korean Americans and European Americans. The results showed that the CES-D model did not fit Korean Americans in terms of the positive affect factor, and degree of acculturation was positively associated with how well the four-factor model fit Korean-Americans (Jang et al., 2010). These results indicate that the CES-D four-factor model may apply to those who are acculturated to a mainstream individualistic culture.

Similarly, another study by Ying et al. (2000) analyzed the fit of the four-factor model of the CES-D in relation to acculturation level. The study sampled 353 Chinese American college students from prestigious universities. Each participant’s level of acculturation was assessed. The factor loading of each item from the sample was compared to that of European American original sample from Radloff (1977)’s CES-D development to a Chinese American community sample (Ying, 1988). Results showed

that the Chinese American college sample fit the four-factor model better than the Chinese American community sample. Although the study did not assess the acculturation level directly, Ying et al. (2000) argued that Chinese American college sample was more acculturated than the Chinese American community sample. However, since the study did not analyze threshold invariance, the measurement invariance between the Chinese American college students and the European American sample is unknown. Nevertheless, the results suggest that the level of acculturation was associated with fit of the four-factor CES-D model.

Although acculturation impacts the fit of the four-factor CES-D, the fit for different collectivistic oriented subgroups may vary. For example, a study suggested that four-factor CES-D fit for Filipino American better than it does for Chinese Americans. Russell et al. (2008) used archival data from the National Longitudinal Study of Adolescent Health (Add Health) and compared the CES-D model among 461 Filipino Americans, 253 Chinese Americans, and 8,548 European Americans. All the participants were between grades 7 and 12. Fifty-six percent of the Filipino American and 44% of the Chinese American and 1% of the European American samples were first generation (born in the United States). Half of the Chinese Americans spoke English at home; by contrast, nearly 75% of the Filipino Americans spoke English at home. The results show that the four-factor CES-D model fits Filipino American and European American, but it does not fit for the Chinese American sample. On the other hand, a three-factor CES-D model (which combines the somatic and negative affect factor together) fit the Chinese American sample well, consistent with findings by Guo (1984) and Ying (1988). Additionally, a model comparison was done between Filipino American and European

Americans, and strict measurement invariance (factor loading and thresholds) was only found in 8 out of 20 items between Filipino Americans and European Americans (Russell et al., 2008). The results indicate that Chinese Americans and Filipino Americans may have different characteristics that represent depressive symptoms compared to European Americans (Russell et al., 2008). The four-factor model fitting Filipino Americans could be because of English predominated in this group and thus Filipino Americans are more acculturated than Chinese Americans.

CES-D cross time applicability

One of the important factors that can affect acculturation is the duration that one person stays within a culture: the longer that a person stays within a culture, the more likely the person is going to be acculturated (Cheung et al., 2011). With regard to measurement of depression, it could be useful to understand how acculturation changes people's perception of depression scale items in order to assess the cross time validity of depression scales. Strict longitudinal measurement invariance (i.e., if factor loading and intercepts are invariant) would indicate that a measurement is valid across two culture groups and two groups respond to the same questionnaire in the same manner. However, if the fit of a model is not applicable across time, it could indicate that acculturation alters people's perception of depression scales. In the case of the CES-D, it is important to know whether the four-factor model of CES-D is longitudinally invariant so the impact of acculturation on the measurement can be understood. .

A study by Motl et al. (2005) used data from the Teens Eating for Energy and Nutrition at School (TEENS) Study (Lytle & Perry, 2001), in which 2,416 adolescents (75.1% European Americans) were asked to fill the CES-D questionnaires through 3

continuous years. The CFA results showed the four-factor CES-D have consistent strict measurement invariance across 3 years (Motl et al., 2005). Therefore, it appears that the CES-D is a longitudinal measurement invariant scale in European Americans.

However, the CES-D is not measurement invariant across time for ethnic groups other than European Americans. A study by Macintosh and Strickland (2010) compared 1,876 non-Hispanic European elderly participants from New Haven, Connecticut with a group that included 2,623 Hispanic elderly European from Western United States. CFA analysis results indicated that Hispanic whites have a systematic bias towards the items included in the positive affect factor compared to the European American. The factor bias was confirmed in another study by Golding and Aneshenel (1989) who found that the elderly Hispanic and non-Hispanics had different factor loadings for the positive affect factor. It suggests that the four-factor model may not be invariant for the Hispanic group across time. Thus, an effective measure to assess the depression of different ethnic groups is needed to develop so that the accurate diagnosis can be attained.

Applicability of the CES-D short version

The regular 20-items CES-D have been researched for 4 decades since its development. In addition to using populations with different characteristics (e.g., age, ethnic, gender) to validate the measure, researchers also added or delete some items to improve the CES-D or even rephrase the questions for adolescents (Perreira, Deeb-Sossa, Harris, & Bollen, 2005). Researchers found that some of the 20 items overlapped with other items (Edwards, Cheavens, & Cukrowicz, 2010) and therefore, a shorter version of the CES-D could improve the assessment of depression across groups and time. A study by Perreira et al. (2005) analyzed the CES-D's original 20 items, and found that 5 items,

including the suicidal ideation item, could serve as a predictor of depression, and the rest of items are redundant because they are only results of depression. The 5-item scale (I felt depressed; life was not worth living; I felt happy; hard to get started doing things; I could not shake off the blues) was analyzed across 12 ethnic groups. The cross ethnic CFA results showed that a 5-item, one-factor model has a good fit for all 12 ethnic groups. Further analysis showed that even after eliminating the suicidal ideation item (most of studies did not include it), the remaining 4-item model was still measurement invariant across 12 ethnic groups including Asian American and European American.

However, while the short version of CES-D improves the fitness of the model and provides a fast method to assess depression, it could also decrease the sensitivity for screening possible depressive patients. The sensitivity of a shorter CES-D version developed by Santor and Coyne (1997) was examined in a sample of 1,928 primary care patients with ages ranging from 17 to 80. The study compared the probability that each item was chosen by non-depressive or depressive persons. Then, the nine items with most discrepancy were selected. The CES-D cutoff points for this version made the model lose 5% of sensitivity for identifying potential depressive patients. Moreover, the above mentioned study by Edwards et al., (2010) suggested that despite overlap between them, the rest of items in CES-D are not redundant. The researchers analyzed the 20-item one-factor model with 595 participants (77% European American). The CFA modification indices (index that tells the model fit could be improved if certain indicator is removed from the model) show that 4 items within the frame of the positive factor could be removed from the model, and the item “ People were unfriendly” which is correlated to the item “ I felt that people dislike me” could also be removed. The remaining 15-item

one-factor model fit for the sample well. Nevertheless, the applicability of this model across cultures is unknown.

Purpose of the study

Many studies have shown that the CES-D is not invariant across samples from individualistic and collectivistic cultures (Kim et al., 2011; Jang, Kwag, & Chiriboga, 2010). However, no studies have analyzed the longitudinal measurement invariance for Asian American and European American teenagers separately. The Asian American and European American represent collectivistic and individualistic value respectively. Studying the measurement invariance of CES-D across Asian American and European teenager groups can help to understand the manifestation of depression across cultures because the dimension of the depression scale, the meaning of the items, and the systematic response bias of depression can be analyzed and compared across groups. Also, examining the longitudinal measurement across groups could help to understand how acculturation influences the fit of CES-D models and manifestation of depression.

Thus, the purpose of this study is to replicate previous methods and analyze the measurement invariance across the Asian American and European American teenagers and also the longitudinal measurement invariance across these two groups for a revised 19-item version of the CES-D.

Research Aims

- 1. Use EFA to test if the CES-D demonstrates dimensional invariance across Asian American and European American adolescent samples.*
- 2. Analyze invariance in CES-D factor loadings and thresholds across Asian Americans and European Americans.*

3. *Analyze CES-D longitudinal invariance for Asian Americans and European Americans separately.*
4. *Modify the 19-item CES-D measure and make it fit for both Asian American and European Americans and the both groups across time.*

METHODS

Data

The data used in this study are from the National Longitudinal Study of Adolescent Health (Add Health) public-use data. The study contains 4 waves that were collected in 4 different periods of time. In Wave I, the in-school questionnaires were distributed to school administrators, and students between 1994 and 1995. A stratified sample was then selected from the adolescents, and these selected participants were interviewed at home. In Wave II, the follow-up in-home interviews were administered to the same participants with the age of 12-20. In Wave III, the same participants were interviewed at home between 2001 and 2002, and their ages were between 18 and 26 years old. Wave IV used the same sample and was collected in 2008, and the participants' age ranged from 24 to 32 years old.

Sample

The sampling frame is based on the Quality Education Database (QED) which contains 26,666 high schools all over the country. The sample was chosen based on systematic sampling method. Eighty high schools which were public or private schools that had at least 30 students and an 11th grade were selected for the study. The enrollment size (125 or fewer, 126 to 350, 351 to 775, 776 or more students), school type (private, parochial, public), the regions of the school (Northeast, Midwest, South, and West), the degree of urbanization (urban, suburban, rural) and European American student percentage (0, 1 to 66, 67 to 93, and 94 to 100) were the factors that used for stratifying the sample. Twenty-eight out of the 80 schools refused to participate in the study, but they were replaced by the schools that were similar to the rejected ones (Add

Health, 2012). Besides, 56 middle and junior high schools whose students attended the 80 high schools are selected for the study. The chance of selecting a middle or junior high school was determined by the students' proportion in the high school. Nevertheless, 52 middle or junior high schools accepted to participate in the study. In all, a total of 132 schools (80 high schools and 52 middle schools) participated in the study. Between 1994 and 1995, the in-school questionnaires were given to more than 90,000 students in the schools. From the students who completed the in-school studies, 20,745 students were selected to complete the in-home interviews between 1994 and 1995. A core sample of 12,105 adolescents was selected randomly from the students in school samples which were stratified on gender and grade. In 1996, a follow-up Wave II in-home interview was conducted by using the same sample from Wave I.

The Add Health public-use data was obtained randomly from the in-home interview core sample, and consisted of one half of the core sample. The purpose of this study is to compare Asian Americans with European Americans in terms of perception of depression. To be categorized as Asian American, people needed to report themselves as Chinese, Filipino, Korean, Asian-Indian, or Vietnamese. Four thousand European Americans and 228 Asian Americans were selected from the public-use data for both waves of the study. However, not everyone participated in the Wave II of study.

Measures

The Add Health used 19-item Center for Epidemiologic Studies Depression Scale (CES-D) which originally developed by to assess participants' depression level (Radloff, 1977). Each item has the range from 0 to 3 (0 =rarely or none of the time, 1= some of the time, 2=a lot of the time, and 3=most or all of the time). The CES-D scale in Add Health

did not include two items: “I have a crying spells” and “My sleep was restless.” Add Health reworded two of the items “I felt that everything I did was an effort” and “I could not get going” from the original 20-item model, and the reworded items helped to assess children’s depression level in the previous studies (Faulstich et al., 1986; Wessman et al., 1980). One extra item (“I felt that my life was not worth living”) was added to the CES-D, and according to Garrison et al. (1991), it served as a good indicator for the depression scale. A full list of modified CES-D items that are used in the Add Health study could be found in Appendix 1.1. In the study, the entire positive affects items (hopeful about the future, happy, enjoyed life, and felt as good as other people) reverse-coded, which means that the higher score means less positive affect.

Procedures

A statistics software Mplus version 6.11 (Muthén & Muthén, 2007) was used in this study for exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and measurement invariance analysis.

The European American sample size was more than 20 times that of Asian American sample. Because the chi-square statistics is sensitive to sample size, it might not be meaningful for comparing model fit for these two groups. To solve the problem, this study randomly chose the same size of the sample from the European Americans to compare to the sample of Asian Americans for both waves in that the chi-square difference tests were able to determine the measurement invariance. Two hundred and twenty-eight Asian Americans and 222 European Americans sample were chosen for both waves. All the participants responded the questionnaire in Wave I; however, 165 Asian Americans and 162 European Americans did so in Wave II.

Based on sample size and preliminary check of the sample, it was found that less than 5% of participants responded to the fourth option (most of the time or all the time) in the questionnaire. This could cause the model unstable. On the other hand, studies have shown that by collapsing the response categories of the variables, the results of factor analysis were generally not affected (Farrington & Loeber, 2000; Hunter & Schmidt, 1990; Muthén, 1984; Muthén & Kaplan, 1985). Thus, the third (A lot of time) and fourth category (most of the time or all the time) were combined for the study.

Research Aim 1: Use EFA to test if the CES-D demonstrates dimensional invariance across Asian American and European American adolescent samples.

To test the first research question, separate efas were conducted for both groups in order to determine whether the factor structure for the European American group and Asian American group were the same. First, the eigenvalue generated from EFA was used to determine the maximum number of factors that each group could have. According to The Kaiser–Guttman rule, any factor model whose eigenvalue was at or above 1.0 would be considered a proper structure (Brown, 2006). If the maximum number of factors was different across groups, the lowest maximum number of factors that represent the model would be used as the same structure for both groups. Second, the model fit indices (CFI, TLI and RMSEA) were help to determine the factor model fit for both groups or not.

Afterwards, a factor model that fits both groups was chosen for further analysis, and the indicators of each item were compared to see if they loaded on the same factor for both groups. In addition, if the factor loadings of items were loaded on a different

factor, they were disregarded from the model and the rest of the items were analyzed in order to establish the measurement invariance.

Research Aim 2: Analyze invariance in CES-D factor loadings and thresholds across Asian Americans and European Americans.

In order to test the second research question, the factor loadings and thresholds of the 19 items (Appendix 1.1) between two groups were compared by using CFA. Since the data were categorical, robust weighted least squares estimator (WLSMV) was used for estimating model parameters.

Measurement invariance was tested in a series of 3 steps. The factor loading invariance would be tested in step 1 and step 2, and the threshold invariance would be tested in step 3. In step 1, the baseline factor model would be estimated so that subsequent models could be compared to the baseline model. The factor loadings and thresholds were freely estimated for both groups. For identification purposes, the factor mean was set to zero for both groups, and scale factors were fixed to one for both groups. Mplus would run the analysis, and generate the chi-square value, comparative fit index (CFI; Bentler, 1990), Tucker-Lewis index (TLI, Tucker & Lewis, 1973) and the Root Mean Square Error Approximation (RMSEA; Steiger & Lind, 1980). According to Brown (2006), when CFI and TLI were equal or above .95, and RMSEA was close to .06 or below, the model would fit the data. Those indices were used to test the fitness of the model for the two groups. Then, the baseline chi-square and the degree of freedom were obtained from the output and the derivatives were saved in a .dat file, which would be compared to the derivatives in the subsequent steps.

In step 2, the factor loadings were set to be equal for two groups. The thresholds were freely estimated. Again, the factor mean was set to zero for both groups, and scale factors were fixed to one for both groups. Mplus would calculate the CFI, TLI, and RMSEA which were used to check the model fit of the two groups. The difference of the chi-square to the degree of freedom between this step and the baseline model from step 1 was calculated by Mplus. If there was not a significant increase in the chi-square to the degree of freedom ratio, the factor loadings were statistically equal between the two groups. Otherwise, the factor loadings across two groups were not equivalent.

In step 3, the factor loadings and thresholds were set to be equal across groups. The factor mean was set to zero and the scale factors were set to 1.00 for one group for identification purposes. For the other group, the scale factors were set to freely vary and the latent factor mean was freely estimated. Then, the CFI, TLI, and RMSEA were generated from Mplus to check the model fit of the two groups. The difference of chi-square to the degree of freedom between this step and the baseline model from step 1 was calculated by Mplus. If there was not a significant increase in the chi-square to the degree of freedom ratio in this step, the thresholds across the two groups were invariant. If the factor loadings and thresholds were the same, the measurement was invariant between two groups.

Research Aim 3: Analyze CES-D longitudinal invariance for Asian Americans and European Americans separately.

In order to test the third research question, the Asian American group and the European American group were analyzed separately across time. Testing the longitudinal measurement invariance across two waves for one group required several steps. Similar

to measurement invariance testing across groups, there were 3 steps to collect the baseline chi-square and degree of freedom, the fixed factor loading chi-square and degree of freedom, and fixed factor loading and threshold chi-square and degree of freedom. CFI, TLI, and RMSEA were used to check the fit of the model in each step. In order to get baseline chi-square and the degree freedom, the thresholds were set to be freely estimated and factor loadings were already freely estimated by default in Mplus. For identification purposes, the factor mean was set to zero for the same factors across time, and scale factors were fixed to 1.00 for both waves of one group. Because the participants filled out the CES-D self-report inventory across two different times, the repeated procedures could generate error that related to the residuals of the three-factor model. Therefore, the covariances between the residuals of the same items of the model across time were identified for each group.

In the second step, the factor loadings for the same items were fixed to be the same across two waves of one group. The fixed factor loading chi-square to its degree of freedom ratio was obtained, and compared with the baseline chi-square to the degree of freedom ratio by Mplus. If there was a significant difference in two chi-squares, the factor loadings were different across waves for a group. The CFI, TLI, and RMSEA were generated from Mplus to check the model fit of the two waves of each group.

In the third step, the threshold invariance was tested. The factor loadings and thresholds were set to be equal across two waves of one group. The factor mean was set to zero for one wave of the group for identification purposes. The scale factors were set to vary freely, and the latent means of the other wave was freely estimated. Mplus calculates the new chi-square to the degree of freedom ratio as well as the model fit

indices such as TLI and CFI. The difference of the new chi-square to the degree freedom ratio was compared with the baseline chi-square to the degree of freedom ratio by Mplus. If there was not a significant increase in the chi-square to the degree of freedom ratio compared to that of baseline model, the thresholds across the two waves of the group were deemed to be invariant. If the 3 steps confirm that the factor loading and threshold invariances, the longitudinal measurement was invariant across two waves of the group.

Research Aim 4: Modify the 19-item CES-D measure and make it fit for both Asian American and European Americans and the both groups across time.

The ultimate goal of this study was to find items that would fit both Asian Americans and European Americans across two time waves to determine whether CES-D could be used to detect the depression level for the Asian American group accurately. The procedures of getting the ideal fit for both groups involved: using modification indices of CFA to detect the items that negatively influence the fit the model, taking the items out and re-analyzing the rest of the items across the groups and waves. It might take several repeated procedures until the items that fit for both group and times were achieved.

RESULTS

Research Aim 1: Use EFA to test if the CES-D demonstrates dimensional invariance across Asian American and European American adolescent samples.

The EFA was conducted for both groups across two waves. By using the Kaiser–Guttman rule, the maximum number of factors for Asian American sample could be extracted by EFA was 3 in wave I and five in wave II respectively, whereas the maximum number of factors was 4 for European American sample for both waves. The three-factor model which was the maximum number of factors that was a fit for both groups was chosen for further analysis. There was evidence that the 3- factor model was an adequate fit for both European Americans in Wave I (CFI = .976, TLI = .965, and RMSEA = .046) and Wave II (CFI = .970, TLI = .956, and RMSEA = .054) and Asian Americans in Wave I (CFI = .987, TLI = .981, and RMSEA = .035) and Wave II (CFI = .980, TLI = .971, and RMSEA = .053).The three-factor model which contained somatic/negative affect (SA), positive affect (PA) and interpersonal affect (IPA) factors fitted the Asian American sample, and consistent with previous studies (Russell, et al.; Ying, 1988). However, five items loaded on different factors in this study, while item 7 (too tired to do things), item 9 (life had been a failure), item 12 (talk less than usual), item 15 (enjoy life), and item 19 (life not worth living) loaded on 3 factors differently across the groups and waves (Table 1.1, Table 1.2).

The EFA results (Table 1.1, Table 1.2) indicated that the not all the items were loaded on the same factors for both groups across two waves. In this study, the factor loading cutoff points was from .35 (Kim, & Mueller, 1978).

In Wave I, the item “too tired to do things” loaded on the SA factor for European Americans, whereas for Asian Americans it loaded on the IPA factor. However, the difference could diminish after a period of time. In Wave II, the item loaded back on the interpersonal affect for both groups.

The item “enjoyed life” loaded on the PA factor for European Americans and Asian Americans in Wave I, while it loaded on the PA factor for European Americans and cross-loaded on both SA factor and the PA factor for Asian Americans in Wave II. The item “talk less than usual” loaded on the SA factor for European Americans and on the IPA factor for Asian Americans across two waves. The difference across groups could be due to the individualism-collectivism difference in perception in this item.

In Wave I, the item “life had been a failure” loaded on the IPA factor for both groups, In Wave II, the item loaded on the PA factor for European Americans, while for Asian Americans it loaded on the SA factor. The item “Life not worth living” loaded on the PA factor for European Americans across two waves; however, it cross-loaded on the SA factor and the PA in Wave I and loaded on the NA factor in Wave II for Asian Americans. The reason of the cross-loading could be an artefact of capitalization of chance.

The next set of analyses used a series of chi-square difference tests to analyse how well a model fitted the data, but the chi-square test was sensitive to sample size. Due to the large sample size discrepancy between European American ($N = 3891$) and Asian Americans ($N = 228$), the test was not able to be carried on. To solve this problem, 222 European Americans were randomly selected from the total European sample for each wave. Multinomial Logistic regression analysis was used to compare between the

selected and the whole European samples on the 19 CES-D items for Wave I and II. Two significant results were found in the item “had blues” in Wave I and the item “felt lonely” in Wave II between the two samples. The rest 36 comparison were not significant. Thus, the EFA models generated by the whole European sample were used to build the CFA models.

In order to further the next research aim which was to analyse the factor loading and threshold invariance, the dimensional invariance had to be achieved. Thus, the 5 items were taken out from the model. The rest of 14 items were compared for factor loading and threshold invariance.

Research Aim 2: Analyze invariance in factor loadings and thresholds across Asian Americans and European Americans.

CFA was used to analyze the factor and threshold invariance of the 14-item three-factor models across the two groups for both waves. There were 3 steps for this aim: first, setup a baseline chi-square between the two groups; second, restrict factor loading and check its invariance; third, restrict both factor loading and threshold, and check the threshold invariance. In Wave I, the χ^2_{diff} between the first and the second step was not significant ($p = .33$), and the χ^2_{diff} between the first and the third was not significant ($p = .35$). In Wave II, the χ^2_{diff} between the first and the second step was not significant ($p = .13$), and the χ^2_{diff} between the first and the third was not significant either ($p = .36$). The 3 step measurement invariance analyses showed that the 14-item CES-D was invariant across the two groups for the two waves (Table 2.1, Table 2.2). The factor loading and threshold invariance suggested that both groups respond to the 14 items with the same perception of the depression factors regarding and without a systematic bias.

Thus, the 14- item CES-D was a measure for depression across two groups at the two different times.

Research Aim 3: Analyze CES-D longitudinal invariance for Asian Americans and European Americans separately.

The longitudinal measurement invariance analyses of the 14-item three-factor model were conducted for both groups across waves. For Asian American group, the χ^2_{diff} between the first and the second step was not significant ($p = .78$), and the χ^2_{diff} between the first and the third was not significant ($p = .86$). Thus, the longitudinal factor loading and thresholds of the three-factor model was invariant for Asian Americans across two waves (Table 2.3). For the European American group, the χ^2_{diff} between the first and the second step was significant ($p = .02$). Therefore, the longitudinal factor loading and thresholds of the three-factor model were not invariant for European Americans (Table 2.4).

The Mplus modification indices for the European American group showed that the chi-square could be reduced the most if the item 10 (fearful) was freely estimated. Thus, further analysis on this item was conducted. First, the factor loading of the item was set freely estimated for item 10 in step 2 of the longitudinal measurement invariance analysis, and then the factor loading and threshold of the item in step 3 of the longitudinal measurement invariance analysis was freely estimated as well. The following chi-square difference tests showed that the chi-square did not increase significantly in step 2 ($p = .30$) and step 3 ($p = .39$) for European Americans (Table 2.5). In other words, without item 10 (feel fearful), the longitudinal measure may be invariant for European Americans ,

indicating that this group European had the same perception of the 13 items regarding depression factors with no systematic bias.

Research Aim 4: Modify the 19-item CES-D measure and make it fit for both Asian American and European Americans and the both groups across time.

Given the previous findings, after item 10 was eliminated, the measurement invariance was re-analyzed across the two groups and two waves. The results showed that 13-item three-factor model was measurement invariant across two groups for the two waves and the longitudinal measurement was invariant for both groups across the two waves (Table 3.1, Table 3.2, Table 3.3, and Table 3.4). The results suggested that the 13 item CES-D had a good validity and could be used to as a depression screening method for both European Americans and Asian Americans across time.

DISCUSSION

The objective of this study was to analyze whether Asian American adolescents who were influenced by collectivistic culture norms perceive the 19-item CES-D the same as the European American adolescents who were influenced mainly by individualistic culture norms. If the 19 items were not perceived in the same fashion by both groups, the study set out to determine which items could be applicable for both groups across time so that a better measure could be used for screening depression for them. Along with the aforementioned goal, another objective of this study is to use measurement invariance to check how individualism–collectivism and time influenced the manifestation of depression.

To begin the analyses, exploratory factor analyses were used to explore the factor structure of the 19 items in Asian Americans and European Americans across waves I and II. The EFA results indicated that the three-factor model which included negative/somatic affect factor, interpersonal affect factor, and positive affect factor were an adequate fit for Asian American and European American adolescent samples. Five items loaded on different factors across groups and across waves. However, the items “life had been a failure” and “life not worth living” cross-loaded on the PA for Asian Americans and European Americans in Wave I, and the item “enjoyed life” cross-loaded on the SA factor for Asian American in Wave II. This was an uncommon finding. Nevertheless, the remaining two items had two characteristics. The first feature was that the two groups have the same perception towards the item across two waves. For example, the item “talk less than usual” loads on SA factor for European Americans for both waves, and it loaded on the IPA factor for Asian Americans for both waves as well.

The second feature was that the two groups had a different perception towards the item in Wave I, and had the same perception towards the item in Wave II. For instance, the item “too tired to do things” loaded on SA factor for European Americans and IPA factor for Asian Americans in Wave I; however, it loaded on SA for both groups in Wave II.

As for the consistent items, the item “talk less than usual” has the stable longitudinal perception differences between the two group, and the item “too tired to do thing” merged onto the same factor for both groups after 2 years, which suggested that acculturation may help Asian American adolescents to gradually adopt the same perception of the item as the European Americans do. The aforementioned study by Soto et al. (2011) suggested that expression suppression was not associated with negative functioning for people in collectivistic culture, but in individualistic culture. The perception bias on item “talk less than usual” could result from the difference in the emphasis on expression. The reason that why this difference did not diminish after acculturation could be that this emphasis differences was not susceptible to change. The item “ too tired to do things” loaded on IPA factor for Asian Americans in Wave I. Nevertheless, these results do not allow making a firm inference about how the individualism-collectivism and time may influence the dimensional change of the items.

The next objective was to analyze measurement invariance of the 14 items. The 3 steps measurement invariance was used to identify whether the 14-item CES-D could be measurement invariant across both groups for two waves. Results showed that the 14 items were answered in the same fashion without any systematic bias by two groups in each wave. However, the longitudinal measurement invariance was not achieved by the 14 items for European American. The item “fearful” was found to be neither factor

loading nor threshold invariant for European Americans across waves; it showed that the two groups responded the item “fearful” with a different ranged pattern and with a systematic bias. After the item was taken out, both of the measurement invariance and longitudinal measurement invariance was rechecked and attained.

There were some limitations in this study. First, collapsing answer options could help analyze a small sample; however it also decreased the correlation r which in turn decreased the strength of the factor loadings (Farrington, 2000). The second limitation was the effect of clustering. During the factor analysis process, the sample was treated as randomized data. In fact, the sample was selected by using stratification which means students might come from the same schools with similar characteristics. Without considering the effect of stratification, the results could be biased. For instance, the parameters of factor analysis would not be accurate (Russell et al., 2008), and the standard error would be lower than the expected value (Muthen & Muthen, 2002). The third limitation of this study was that the 19 items CES-D that were used in this study were revised items of the 20 item CES-D developed by Radloff (1977). The sample that Radloff used to create the CES-D only included participants who were over 18 years old. Our study used a sample of adolescents, and most of them were younger than 18 years old. The perception difference between youth and adults on the items were unknown.

In summary, our findings suggested that there were items of CES-D that were perceived differently by Asian American and Europe Americans. Additionally, some perceptual difference between individualistic and collectivistic groups could be diminished by acculturation, whereas others could not. The 13 items of CES-D remained stable for these both groups across time, which indicated that these items

represented overlapping concept of depression for Asian Americans and European Americans. However, to utilize the new 13 items as a depression screening method across groups, new sample should be collected and new threshold for diagnosis of depression could be established.

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Appendix 1.1

Four-factor model of CES-D items in Add Health

Negative Affect Items:

- (6) You felt depressed.
- (9) You thought your life had been a failure.
- (16) You felt sad.
- (3) You felt that you could not shake off the blues, even with help from your family and your friends.
- (1) You were bothered by things that usually don't bother you.
- (19) You felt life was not worth living.

Positive Affect Items:

- (8) You felt hopeful about the future.
- (11) You were happy.
- (15) You enjoyed life.
- (4) You felt that you were just as good as other people.

Somatic Complaint Items:

- (2) You didn't feel like eating, your appetite was poor.
- (5) You had trouble keeping your mind on what you were doing.
- (7) You felt that you were too tired to do things.
- (10) You felt fearful.
- (18) It was hard to get started doing things.
- (13) You felt lonely.
- (12) You talked less than usual.

Interpersonal Relations Items:

- (14) People were unfriendly to you.
- (17) You felt that people disliked you.

Table 1.1

Factor loadings of 3- factor model for all European Americans and Asian Americans in

Wave I

	European Americans($n = 3891$)			Asian Americans($n = 228$)		
	SA	PA	IPA	SA	PA	IPA
Bothered By Things	0.681	0.004	-0.054	0.776	-0.163	-0.028
Poor Appetite	0.544	0.061	-0.070	0.604	0.028	-0.081
Had The Blues	0.930	0.022	-0.179	0.887	-0.009	-0.061
Just As Good As Other People	-0.079	0.658	0.077	-0.036	0.706	-0.028
Trouble Keeping Mind Focused	0.506	0.047	0.087	0.561	-0.053	0.046
Felt Depressed	0.959	0.003	-0.139	0.637	0.226	0.050
Too Tired To Do Things	0.495	-0.070	0.139	0.213	0.122	0.377
Hopeful About The Future	-0.143	0.758	-0.013	-0.128	0.832	-0.007
Life Had Been A Failure	0.349	0.395	0.215	0.503	0.414	0.055
Fearful	0.473	-0.052	0.189	0.392	0.154	0.228
Happy	0.073	0.783	-0.068	0.006	0.748	0.150
Talked Less Than Usual	0.419	0.031	0.007	0.106	0.022	0.322
Felt Lonely	0.757	-0.002	0.019	0.653	-0.012	0.264
People Unfriendly To	-0.065	0.022	0.854	-0.016	-0.032	0.655

You						
Enjoyed Life	0.009	0.838	0.025	0.060	0.550	0.130
Felt Sad	0.822	-0.032	0.015	0.635	0.017	0.370
Felt People Dislike You	0.027	0.164	0.759	0.003	-0.007	0.935
Hard To Start Doing Things	0.459	-0.107	0.184	0.468	-0.021	0.180
Life Not Worth Living	0.340	0.397	0.252	0.493	0.497	-0.025

Table 1.2

Factor loadings of 3- factor model for all European Americans and Asian Americans in

Wave II

	European Americans (<i>n</i> = 2945)			Asian Americans (<i>n</i> = 165)		
	SA	PA	IPA	SA	PA	IPA
Bothered By Things	0.773	-0.042	-0.091	0.573	-0.121	0.241
Poor Appetite	0.636	-0.004	-0.102	0.664	0.024	-0.103
Had The Blues	0.858	0.107	-0.129	0.893	0.151	-0.111
Just As Good As Other People	-0.022	0.636	0.068	0.189	0.634	0.018
Trouble Keeping Mind Focused	0.701	-0.132	0.015	0.577	-0.264	0.127
Felt Depressed	0.839	0.105	-0.066	0.975	-0.032	-0.165
Too Tired To Do Things	0.600	-0.072	0.054	0.549	-0.112	0.181
Hopeful About The Future	-0.079	0.752	-0.016	-0.005	0.829	0.211
Life Had Been A Failure	0.284	0.422	0.264	0.641	0.306	0.024
Fearful	0.498	-0.074	0.156	0.545	0.021	0.181
Happy	0.042	0.772	0.001	0.313	0.598	0.043
Talked Less Than Usual	0.481	0.019	0.066	0.165	0.192	0.353
Felt Lonely	0.583	0.084	0.189	0.812	0.078	0.01
People Unfriendly To	-0.049	-0.006	0.796	0.026	-0.009	0.649

You						
Enjoyed Life	0.049	0.807	0.016	0.456	0.662	-0.059
Felt Sad	0.803	0.031	0.040	0.942	-0.025	0.030
Felt People Dislike You	0.019	0.095	0.812	0.003	0.216	0.849
Hard To Start Doing Things	0.583	-0.191	0.112	0.356	0.019	0.335
Life Not Worth Living	0.233	0.436	0.287	0.847	0.033	-0.157

Table 2.1

14-item Wave I measurement invariance analysis across Asian Americans (N=228) and European Americans (N=231)

	χ^2		<i>Df</i>	χ^2_{diff}	Δdf	<i>P</i>
	AA	EA				
Baseline	121.12	90.26	148			
Factor loading fixed	116.92	93.46	159	12.48	11	0.33
Factor loading & Threshold fixed	124.95	103.89	170	23.89	22	0.35

Table 2.2

14-item Wave II measurement invariance analysis across Asian Americans (n=165) and European Americans (N=183)

	χ^2		<i>Df</i>	χ^2_{diff}	Δdf	<i>P</i>
	AA	EA				
Baseline	111.61	97.02	148			
Factor loading fixed	106.29	109.91	159	16.23	11	0.13
Factor loading & Threshold fixed	117.50	107.76	170	23.60	22	0.36

Table 2.3

14-item longitudinal measurement invariance analysis across two waves for Asian

Americans

	X^2	Df	X^2_{diff}	Δdf	P
Baseline	409.14	321			
Factor loading fixed	401.87	332	7.21	11	0.78
Factor loading & Threshold fixed	424.49	360	29.70	39	0.86

Table 2.4

14-item longitudinal measurement invariance analysis across two waves for European Americans

	X^2	Df	X^2_{diff}	Δdf	P
Baseline	350.72	321			
Factor loading fixed	382.35	332	23.37	11	0.02
Factor loading & Threshold fixed	409.56	360	59.02	39	0.02

Table 2.5

*Item 10 freely estimated longitudinal measurement invariance analysis across two waves
for European Americans*

	X^2	Df	X^2_{diff}	Δdf	P
Baseline	350.72	321			0.12
Factor loading fixed	359.66	331	11.81	10	0.30
Factor loading & Threshold fixed	386.29	357	39.69	36	0.39

Table 3.1

13-item Wave I measurement invariance analysis across two groups

	X^2		Df	X^2_{diff}	Δdf	P
	AA	EA				
Baseline	101.06	85.26	124			
Factor loading fixed	89.06	81.77	134	7.90	10	0.64
Factor loading & Threshold fixed	104.95	93.91	144	18.36	20	0.56

Table 3.2

13-item Wave II measurement invariance analysis across two groups

	X^2		Df	X^2_{diff}	Δdf	P
	AA	EA				
Baseline	104.60	84.15	124			
Factor loading fixed	95.58	90.42	134	11.20	10	0.34
Factor loading & Threshold fixed	108.39	91.69	144	19.27	20	0.50

Table 3.3

13-item longitudinal measurement invariance analysis across two waves for Asian

Americans

	X^2	Df	X^2_{diff}	Δdf	P
Baseline	357.50	271			
Factor loading fixed	349.16	281	6.28	10	0.79
Factor loading & Threshold fixed	370.30	307	27.09	36	0.86

Table 3.4

13-item longitudinal measurement invariance analysis across two waves for European Americans

	X^2	Df	X^2_{diff}	Δdf	P
Baseline	307.07	271			
Factor loading fixed	317.21	281	12.43	10	0.26
Factor loading & Threshold fixed	343.70	307	41.25	36	0.25