# A MEASURE OF POSITIVE AND NEGATIVE AFFECT USING CARTOON FACIAL EXPRESSIONS OF EMOTION

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"I know you have the will to win. Do you have the will to prepare?"
- *Juma Ikonga*

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# Chapter 1
# Introduction

In 1872, Charles Darwin wrote the book Expression of Emotions in Man and Animals and rescued the study of emotions from the pseudosciences of physiognomy and phrenology (Fridlund, 1994) where physical characteristics emphasizing facial features and the contour of the head, respectively, determined temperament and personality traits (Aiken, 1997). Since Darwin (1872), a variety of methods have been developed to measure affect, from the very simple (and unscientific) "mood ring" to the highly sophisticated processes of brain imagery (e.g., magnetic resonance imaging and positron-emission tomography). One particular method of assessing mood consists of using words as descriptors of emotion in self-report measures of affect. These relatively homogenous measures target a variety of emotional states and traits (e.g., anger, anxiety, and positive affect) but exclusively use words or descriptive terms to represent an emotion. Several problems can occur when using words, especially as descriptors of emotion. Some of these problems include ambiguity or lack of familiarity. Often times a researcher will dismiss a word because it highly correlates with several scales or because the participants will not recognize the word and leave the item unanswered. Another problem is the inability to translate a word into another language - or even worse - the mistranslation of a word. For example, Hilleras, Jorm, Herlitz, and Winblad (1998) conducted a study that translated a measure of mood into Swedish, but excluded the word "excited" after gathering data because it was thought the translation may have been interpreted as "sexual" excitement.

These problems have fueled an existing controversy that targets the paradox between positive and negative affect (i.e., the polarity and independence of these mood descriptors). For example, it is logical to conclude that if a person is happy, they could not also be sad at the same time. Conceptually, happy (i.e., positive affect) is the bipolar opposite of sad (i.e., negative affect); having a −1.0 correlation between the two (numerous studies have supported and defied this logic). This area of research, however, has been plagued by a lack of clarity regarding the definitions and indiscriminant use of the terms - positive and negative affect - resulting in a "pseudocontroversy" (Russell & Carroll, 1999a; Watson & Tellegen, 1999, p. 602).

The core of this controversy is best illustrated by Russell's (1980) circumplex model versus Watson and Tellegen's (1985) model of emotion. Russell's (1980) model arranges descriptors of emotion in a circular pattern of bipolar opposites using two orthogonal dimensions, Activation and Valence (i.e., pleasantness-unpleasantness), to account for emotion space. The pleasant and unpleasant halves of the Valence dimension (bisected by Activation) are referred to as positive and negative affect, respectively (Russell, 1980; Russell & Carroll, 1999a). Russell's model emphasizes the bipolarity of positive and negative affect. Watson and Tellegen's (1985) model, on the other hand, rotate the dimensions 45 degrees and names them Positive Affect and Negative Affect, emphasizing the independence of positive and negative affect. These models of emotion represent the extremes of bipolarity versus independence. This may help explain why researchers have reported low (i.e., independent) to strongly negative (i.e., bipolar) correlations between positive and negative affect (see Figure 1). Unfortunately, this range of findings has created a "terminological muddle" that Watson and Tellegen (1999) refer to as "so confused at this point the terms 'positive affect' and 'negative affect' perhaps should indeed be used only as inclusive terms referring to any positive and negative feeling states" (p. 603).

Avoiding the disadvantages that are incurred when using words as descriptors of emotion in self-report measures is a difficult task, but it can be accomplished with a nonverbal approach. Nonverbal approaches to measuring mood include body language, voice inflection, and especially - facial expressions. Facial expressions have been used in research to establish the validity of semantic labels - allowing researchers to compare the structural similarities between the nonverbal and verbal domains (Katsikitis, 1997; Osgood, 1966; Russell & Bullock, 1985). Photographs of facial expressions have also been used in the classification of emotions, the investigation of encoding and decoding emotions, and the cross-culture or universal interpretations of facial expressions (e.g., Eckman & Friesen, 1971; Izard, 1971). At least six universal facial expressions of emotion have been identified; anger, enjoyment, fear, disgust, surprise, and sadness with some evidence supporting the expressions of contempt and interest (Ekman, 1993; Ekman & Keltner, 1997). Because facial expressions are less ambiguous, seen everyday, and universally recognized, they seem to be a valuable alternative to words in self-report measures of mood, however, they have not been utilized for this purpose.

Purpose of the Study

The purpose of this study was to test an alternative source of items for use in self-report measures of affect. Specifically, cartoon facial expressions of emotion were utilized to develop an instrument (i.e., the Facial-Positive Affect Negative Affect Schedule; F-PANAS) to assess positive and negative affect. The Positive Affect Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988), which uses words as descriptors of emotion, was included to investigate the relationship between verbal and nonverbal domains of affect as measured by the PANAS and F-PANAS, respectively.

Regardless of the paradox surrounding positive and negative affect, scales designed to assess them have tied them to other psychological constructs. For example, extroversion correlates with positive affect while high negative/low positive affect relate to measures of depression (Watson, Clark, & Tellegen, 1988). Costa and McCrae's (1992) NEO-Five Factor Inventory (NEO-FFI) and Spileberger's (1995) State Trait Personality Inventory (STPI) were used in this study to investigate the relationship between personality constructs and affect as it is measured by the F-PANAS.

In addition to the development of the F-PANAS and the confirmation/exploration of relationships between affect and personality constructs, comparing the positive and negative subscales of the F-PANAS provided insights into their polarity and independence. Bipolarity is indicated by a strong negative correlation while a weak (i.e., near zero) correlation indicates independence of the two constructs.

Significance of the Study

The importance of providing alternative stimuli to measure affect impacts three areas. First, using cartoon facial expressions to create a measure of positive and negative affect removes the complexity and ambiguity of language. Items are frequently left blank because the participants are unfamiliar with a word. Sometimes a researcher removes a word from a scale because it is strongly related to more than one scale (i.e., an ambiguous item). Researchers themselves are found to quibble over the meaning of a word and how that word should be classified. For example, should sad and depressed be classified as unpleasant (Russell, 1980) or low positive affect (Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999)? The use of cartoon facial expressions should address these problems associated with using words as descriptions of emotion in self-reported measures of affect.

Secondly, using cartoons versus photographs of facial expressions allows the control (if not removal) of extraneous variables or irrelevant information (e.g., gender, race, age, attraction, etc.). Researchers have known for some time that the more attractive/unattractive a model is - the more of an effect the model can have. Significant differences in male versus female faces also exist. Masculine faces tend to have a square jaw and chin with thinner lips and larger nostrils while feminine faces tend to have a more oval appearance with thicker lips and smaller nostrils. Facial expressions are also recognized across cultures, allowing the meaning of the item to be retained without the need for translation (or mistranslation). However, to avoid a bias of racial characteristics portrayed by a face, a cartoon only using the basics (i.e., round head, eyes, eyebrows, and mouth) provides a neutral stimulus regarding race, gender, and age, with only the archetype of the emotion being expressed.

Thirdly, the value of research is measured by its fruitfulness. In addition to providing a useful measurement of affect, future research can explore the potential use of this self-report measure (and alternative stimuli) with specific populations. Young children, for example, when asked how well an emotion term describes how they are feeling, may have an insufficient vocabulary that prevents a valid response. The development of an affect scale for children by Laurent et al. (1999) excluded 16 words (e.g., irritable, hostile, distressed, inspired, and enthusiastic) because fourth and eighth grade children indicated that they did not understand the words. On the other hand, young children are able to recognize facial expressions of emotion, but lack the vocabulary to accurately label certain expressions with a word. For example, when a five-year-old is shown a cartoon facial expression of disgust and asked what the face looks like, the child may shrug his/her shoulders. However, if a child is asked, "When would you make a face like this?" they are likely to answer, "When I don't like something." Because these alternative stimuli are nonverbal, the language barrier is removed. Not only would this allow the instrument to be used with children, but any population with limited language abilities or populations across cultures.

# Chapter 2
# Review of the Literature

There are five relevant areas in the literature that were examined in order to integrate an appropriate solution to the complexities of using words as emotion descriptors. First, the background of the problem is presented and defined. Second, the problem is illustrated within the theoretical framework of mood research by using two modern models of emotion. Third, a review of the research on facial expressions identifies their potential as an alternative item pool to words. Fourth, the relationships of positive and negative affect with other psychological constructs are presented along with an emphasis on constructs whose relation with positive and negative affect are in need of further clarification. And fifth, from a psychometric perspective, specific concerns are examined when developing a measurement of self-reported affect.

## The Problem: Words as Descriptors of Emotion in Self-Report Measures

Self-report measures of mood consist exclusively of words or descriptors of emotion, and there is an endless supply of these items. It takes very little effort to compile a list of emotions in excess of 200 items. The abundance of words to describe affect has left this area overly defined. However, it also takes very little effort to group these descriptors into a significantly smaller number of categories (Ekman, 1993). For example, hostile, fuming, furious, enraged, and fierce are descriptions of anger while joyous, enthusiastic, excited, and sparkling are descriptions of happiness. However, researchers frequently dispute the classification of a word and/or its meaning. To illustrate this point, Green, Goldman, and Salovey (1993) included the words "calm" and "relaxed" as bipolar opposites of "distressed" in a scale for negative affect. When Green et al. compared a negative affect scale with a positive affect scale, the scales appeared significantly correlated ($r = -.51$). But, Tellegen and Watson (1999a) argued that the words used in the negative affect scale were weak or "insufficiently pure" markers of negative affect and that all the words needed to be of high-activation negative affect (e.g., scornful, distressed). In addition, Tellegen and Watson dismissed the −.51 correlation by stating that it accounted for less than 30% of the variance; therefore, they interpreted Green et al.'s (1993) scales as being mostly independent. As you can see, most of the confusion has been caused by Watson and Tellegen's (1985) classification of "calm", "relaxed", "placid", and "at rest" as low negative affect rather than low positive affect, which appears to be counterintuitive.

These are just a few examples of the confusion that exists in the emotion research literature. Controversies surround the area of self-reported measures of affect, fueled by the ambiguity that words (as descriptors of emotion) introduce into the disputes over classification, selection of items, and the naming or definition of an underlying construct or dimension itself. Most of these controversies concern the polarity and independence of positive and negative affect, but these conflicts have risen not from a lack of agreement regarding theory, but from a lack of clear definitions. Researchers have indiscriminately used the terms positive and negative affect that have resulted in this "pseudocontroversy" (Watson & Tellegen, 1999; Russell & Carroll, 1999a). Watson & Tellegen (1999) describe this area of literature as "so confused at this point that the terms 'positive affect' and 'negative affect' perhaps should indeed be used only as inclusive terms referring to any positive and negative feeling states" (p. 603).

At the center of this nebulous arena of terminological warfare, reside two models of emotion space that are best explored in order to understand the misunderstandings. Stated another way, the problems incurred by using words as stimuli in self-report measures of mood are entangled in theory; therefore, a comparison of two theoretical models of emotion space will help shed light on the problem while providing a theoretical framework.

Models of Emotion

In describing models of emotion, two theoretical approaches have come to the forefront. Russell's (1980) circumplex model of emotion arranges terms of emotion (e.g., tense, calm, happy, excited, etc.) in a circular pattern of bipolar opposites. The two primary axes of this model are Valence (a *bipolar* dimension consisting of pleasantness-unpleasantness) and Activation (a *unipolar* dimension consisting of activation-deactivation) (Russell & Carroll, 1999a).

Watson and Tellegen (1985) created a model of emotion that was similar in its comparison to Russell's (1980) model. The slight dissimilarities however, are not only significant, but a source of heated debate. Tellegen & Watson (1985) use "alternative" axes, or a 45 degree rotational variant, of Russell's model stating that their structure of affect was "designed to resemble Russell's (1980) circumplex" but at the same time is not a circumplex model (Watson & Tellegen, 1985; Watson, Wiese, Vaidya, & Tellegen, 1999, p. 821). Watson and Tellegen's (1985) two independent axes are Positive Activation (a *bipolar* dimension consisting of high positive activation – low positive activation) and Negative Activation (a *bipolar* dimension consisting of high negative activation – low negative activation). While these "alternative" axes are recognized by Russell's (1980) model, the labels regarding two of the four poles (i.e., the ends of the alternative axes) are in dispute. Specifically, the poles that Watson & Tellegen (1985) refer to as Low Positive Activation (with terms of dull and sleepy) and Low Negative Activation (with terms of calm and relaxed), are referred to by Russell (1980) as Negative Affect/Low Activation (with terms of depressed and bored) and Positive Affect/Low Activation (with terms of calm and tranquil), respectively (Russell & Carroll, 1999). Simply put – both models include low activation poles of the alternative axes, but these 90 degree poles (which are only half of the axes) replace each other across models. [Note: this effect is easily demonstrated by laying two bread-ties orthogonal to each other and twisting the middle to rotate the two low activation poles – while the two high activation poles remain fixed.]

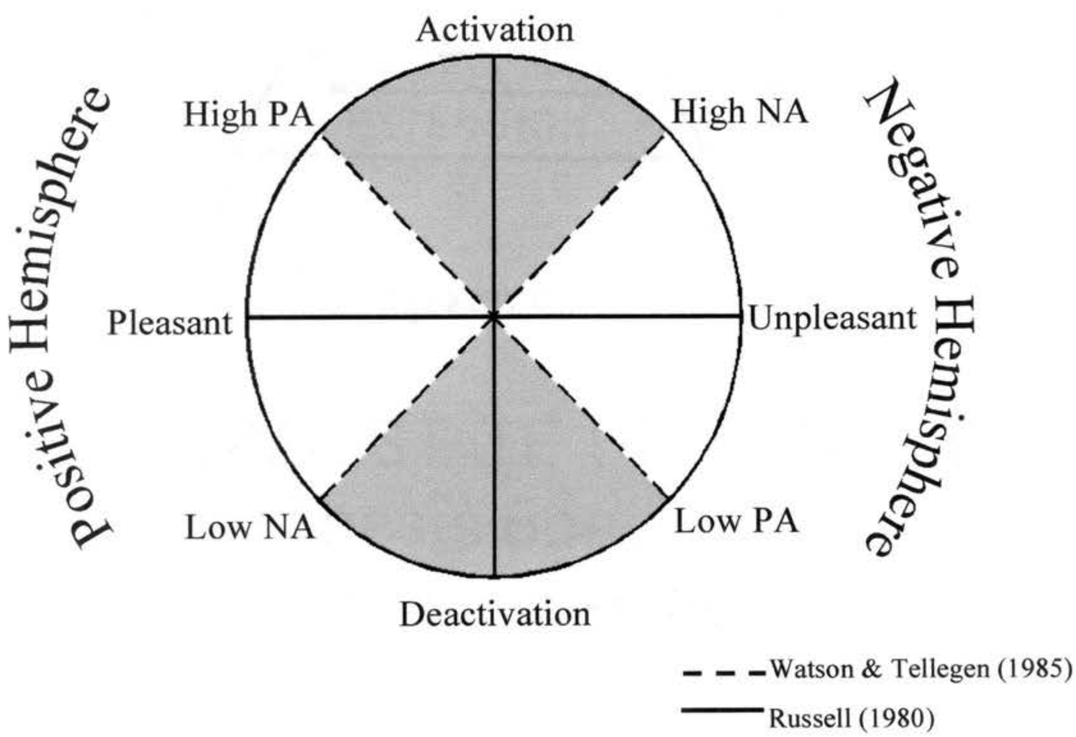


Figure 1. Mixed up Models of Emotions. Note: PA = Positive Affect, NA = Negative Affect.

By labeling their (i.e., Watson & Tellegen, 1985) low activation poles with the same affect connotation as the high active pole (i.e., positive or negative); the Low Positive Affect pole bisects the quadrant comprised of Russell's (1980) orthogonal poles of Unpleasantness and Deactivation. This is counter-intuitive and misrepresents the bipolar dimensions as being unipolar, not to mention that the word positive appears in the negative hemisphere (see Figure 1). Recently, Tellegen et al. (1999a; 1999b) proposed a hierarchical model of emotion that consists of (1) the "omnipresent" Valence dimension followed by (2) Positive Activation and Negative Activation, and (3) discrete emotions.

This hierarchical model of emotions may have implications with physiological components. Watson et al. (1999) linked Fowles' (1987) behavioral inhibition system (BIS: responsible for withdrawal) and behavioral facilitation system (BFS: responsible for approach) to negative and positive affect, respectively. Interestingly noted by Watson et al. (1999), the BIS and BFS may reside exclusively in the right and left hemispheres, *respectively* (Tomarken & Keener, 1998). This is intuitively appealing because the right hemisphere of the brain, with the activation of the BIS, will withdraw from an aversive stimulus without slowing to process the threat with language - until later when language can be used to analyze and store the event. If the right hemisphere had to process a threat with language, response times would slow - and survival would be compromised. In short, survival depends on the ability to react quickly to a threat and the additional processing time required by language only slows the time it takes to react. As for the left hemisphere, if an event is pleasurable, one can "mentally masturbate" over the pleasurable experience, reliving it in the rich description of words at a leisurely pace.

From an evolutionary standpoint - the importance of survival would prepare one to meet a variety of threats (i.e., a diversification of negative emotions suited for the aversive situation). For instance, when faced with a threat - activation of fight or flight (i.e., anger or fear) can occur. But, when faced with something appetitive, approach is the only evolutionary adaptation. Stated simply, when something is pleasant - the result is positive emotion. However, when something is unpleasant - a variety of negative emotions can occur. This is reported to be the case by Watson et al. (1999) with relatively few "pure markers" of high positive affect, while there is an abundance of "pure markers" of high negative affect. According to Watson et al., the greater number represents importance. This is also reflected in the number of positive and negative facial expressions that are universally recognized.

Facial Expressions of Emotion: An Alternative

An alternative item pool of mood descriptors, rather than words, can be found in the area of facial expressions of emotions. While the study of emotions using facial expressions is not new (Eckman & Friesen, 1971; Izard, 1971), facial expressions have not been utilized in self-report measures of affect. A review of the literature in this area reveals extensive research regarding their universality, definitions, classification, and consensus.

Numerous studies have used words to develop measurement scales of affect, while nonverbal approaches, specifically facial expressions (typically photographs of real human faces), have been used in research to establish universal meaning, classification, identifying, or en/decoding. Facial expressions have also been used (although with less frequency) to establish the validity of semantic labels (and vice versa); allowing researchers to compare the structural similarities between the verbal and nonverbal domains (Alvarado, 1996; Katsikitis, 1997; Osgood, 1966; Russell & Bullock, 1985). While facial expressions of emotion and the words that are used to describe them are similar, words are more developed and complex (and in greater abundance) in order to express the subtleties of emotion. A limitation, or at least a distinction, is made between terms and facial expressions of emotion by Ekman (1994) when he states "matching up words & faces is imperfect . . . because they convey what the other may not" (p. 270). Facial expressions of emotion, on the other hand, are considered more discrete (Ekman, 1993). There are also fewer universal expressions of emotion than there are words that describe emotion. Ekman (1993) states: "...the list of emotions that have a universal facial expression is far shorter than the number of emotions most theorists have proposed, far smaller indeed than the various words for emotion" (p. 387). Tellegen et al.'s (1999a; 1999b) hierarchical model postulates that positive affect and negative affect can be broken down into basic (discrete) emotions and measured. Tellegen et al.'s (1999a) study included nine discrete affect categories modeled after Izard's (1972; 1991) Discrete Emotion Scale.

Psychological Constructs Related to Positive and Negative Affect

Positive and negative affect are "logically" bipolar, yet their independence has been validated, replicated, and contested, over recent decades. Regardless of the controversy that surrounds the measurement of positive and negative affect, researchers have consistently developed scales to measure them, and have related them to other psychological constructs (e.g., extroversion, neuroticism, and depression). McCrae and Costa (1995) investigated the possibility of including positive and negative affect as two additional factors to the five-factor model but rejected this idea concluding they were not "fundamental factors in description of personality, [but] they are potentially important in understanding self-appraisals" (p. 443). They also concluded that significant relationships existed between positive affect and assertiveness along with low modesty while negative affect was related to depression and low competence. This is consistent with Costa and McCrae's (1980) earlier research that found a strong relationship between positive affect and extroversion while negative affect was strongly related to neuroticism (see also Watson et al., 1988 and Watson et al., 1999). In addition, low positive affect and high negative affect have been linked with anxiety (Watson et. al., 1988). These results would seem to indicate the independence of the positive and negative affect because they each relate to different personality constructs.

A recently developed personality test, the State-Trait Personality Inventory (STPI; Spielberger, Jacobs, et al., 1995), includes the personality scales to measure Curiosity, Anger, Anxiety, and Depression. While the previously cited studies have already established the relationships between positive and negative affect with Anxiety, Depression, and Anger -- the relationship with Curiosity has not been explored. The additional aspect of the state-trait perspective, especially how it relates to state-trait affect (i.e., "how do you feel right now" versus "how do you feel in general") may provide some insights.

Specific Psychometric Considerations

There are several important psychometric issues that are specific to the development of a self-report measure of positive and negative affect that need to be addressed. These issues include measurement error (Green, Goldman, & Salovey, 1993), the selection of terms (Watson & Tellegen, 1985, Watson et al., 1988), time frame (Warr, Barter, & Brownbridge, 1983), and response format (Russell & Carroll, 1999; Warr, Barter, & Brownbridge, 1983); all of which add to the complexity of the problem.

Measurement error can be random or systematic. Green et al. (1993; 1999) recommended using confirmatory factor analysis and multiple response formats (i.e., checklists, "describes me", agree-disagree, etc.) in order to identify random and systematic error. These sources of error attenuate the correlation coefficient away from bipolarity. The disadvantage of using multiple formats is that the researcher must develop equal or parallel formats - not an easy task. Tellegen et al. (1999) took a different approach to measuring nonrandom error by using a single format, but included questions that assessed a respondent's acquiescence (a type of systematic error; Bradburn, 1969; Green et al, 1993; Tellegen et al., 1999). Tellegen et al. also made an argument that while correcting coefficients for random and systematic error increase their accuracy, it does not change their underlying nature or relationship (i.e., raw correlations are still valuable in order to understand the relationship between constructs).

The selection of emotion terms themselves is another concern in assessing positive and negative affect (Watson & Tellegen, 1985, Watson et al., 1988). The PANAS (Watson et al., 1988) was developed using only highly activated positive and negative words (e.g., excited and fearful, respectively). The developers cautioned against the use of moderately activated terms that were related (e.g., happy and sad) in order to develop independent measures of positive and negative affect. This fact may explain the variation of low to high correlations that researchers have found when studying the polarity and independence of positive and negative affect (see also Russell & Carrol, 1999a, Watson

& Tellegen, 1985, Watson & Tellegen, 1999). That is to say, items taken from the bipolar ends of the pleasantness-unpleasantness dimension will result in strong negative correlations. However, if items are taken from the poles that are a combination of the bipolar and unipolar dimensions of pleasantness-unpleasantness and activation, respectively, suppressed correlations can occur. Thus, a variety of scales that deviate away from the bipolar dimension can result in high to low negative correlations depending on how close or far, respectively, the words deviate from the dimension.

Asking participants how they feel right now (i.e., state affect) can result in a greater degree of bipolarity than if you ask participants how they feel in general (Warr, Barter, & Brownbridge, 1983) although Watson et al.'s (1988) research did not support this. Russell and Carroll (1999b) argued against retrospective memory, charging that it is susceptible to faulty reconstruction. However, how one feels in general addresses their traits; something that is fairly stable and helps predict the behavioral pattern of an individual when they are placed in specific situations. During a "situation", an individual is in a particular state of emotion (e.g., fear, anger, anxiety). Referring to anxiety, Spielberger (1983) defines a trait as a "proneness" to react that is evidenced by its manifestation in a greater number of contexts or situations. This "proneness" to react is related to the frequency, intensity, and duration of the emotion (Spielberger & Sydeman, 1994). This relation of state and trait measures of psychological constructs result in strong correlations, however, trait measures remain stable with higher test-retest coefficients while state measures tend to fluctuate.

Spielberger and Sydeman (1994) credit Cattell's (1966b) research on anxiety as an early pioneer that made a distinction between state and trait characteristics. Cattell reported a relation between physiological measures with state anxiety but not trait anxiety - a result that indicates two unique aspects of the same emotion. Spielberger (1988) has extended Cattell's work regarding anxiety and has added to that state and trait measures of depression, anger, and curiosity (Spielberger, Jacobs, et al., 1995; Spielberger, Ritterband, Sydeman, Reheiser, & Unger, 1995; Spielberger & Star, 1994).

The last concern regarding the assessment of positive and negative affect is the format that the participants use to make a response (i.e., response format). Russell and Carroll (1999a) and Watson and Tellegen (1999) agree that a bipolar format forces a structure of bipolarity and cannot be used for a test of bipolarity. A bipolar format, for example, containing depressed and excited appears below:

Circle the number that best describes your current feelings:

| Depressed | | | | | | | neutral | | | | | | | Excited |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -7 | -6 | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

The more familiar unipolar response formats (e.g., Likert) on the other hand, allow one to investigate unipolar and bipolar structures without imposing bipolarity into the responses (Russell & Carroll, 1999a; Watson & Tellegen, 1999). It should be noted that Russell and Carroll (1999a) argued that it has already been established that positive and negative affect are bipolar and therefore a bipolar format is more preferable while Watson and Tellegen (1999) urge the use of a unipolar format as more versatile and pragmatic.

<u>Conclusions</u>

The review of the literature presented the complexities of using language to represent emotion. This included emotion space as being largely overly defined; resulting in the battle of the definition and categorization of words as they relate to mood. Two current models, Russell (1980) and Watson and Tellegen (1985), were reviewed to illustrate the debate that can occur over the definition and classification of words used as descriptors of emotion. As an alternative to words, research that has been conducted on the recognition of emotion in facial expression indicates that certain facial expressions of emotion are recognized across cultures (Eckman & Friesen, 1971). Because facial expressions escape the confines of language that are tied to culture, the use of facial expressions in self-report measures of mood are promising.

The purpose of this study, therefore, was to examine the potential use of cartoon facial expressions of emotion as an alternative source of items and to develop a self-report measure of positive and negative affect utilizing these items. As a psychometric study that was designed to develop a new self-report measure of affect, the issues related to item selection and the format of the responses that can effect the relationship of positive and negative affect were presented. Specifically, how items are selected and the variation of response formats can influence the relation between positive and negative affect.

# Chapter 3
# Method

## Participants

The sample for this study (N = 375) came from a student population enrolled at a regional state university in the Midwest. Participants were given credit in partial fulfillment towards a research requirement or extra credit for their participation. All participants were provided with an informed consent form (see Appendix F) and treated in accordance with the ethical guidelines set forth by the American Psychological Association (1992), the Oklahoma State University's Institutional Review Board (www.vpr.okstate.edu/irb/), and the University of Central Oklahoma's Institutional Review Board (www.ucok.edu/facres/humans.html).

## Research Design

This was a psychometric study. It contained both reliability and validity components regarding the development of a self-report measure of positive and negative affect utilizing cartoon facial expressions of emotion. Item and scale reliabilities were used to estimate the amount of measurement error within the new instrument. In addition, 40 participants were tested a second time – providing information regarding test-retest reliability or temporal stability of the instrument (i.e., high stability for trait affect and low stability for state affect).

Initially, judges provided content validity by identifying cartoon facial expressions of emotion (see Appendix B) to be used as items in the Facial-Positive Affect Negative Affect Scales (F-PANAS; see Appendix A). Construct validity was investigated by using a principal component analysis with varimax and promax rotations. Inter-correlations within the F-PANAS and between the PANAS subscales provided convergent and discriminant validity (another type of construct validity). That is to say, if positive and negative affect are independent, then lower inter-correlations would be expected, while higher inter-correlations would be expected of positive affect across the two measures (i.e., the F-PANAS & PANAS) - as well as negative affect.

The inter-correlations between the subscales of the F-PANAS, NEO-FFI, and STPI were expected to confirm past research that has established relationships with several of the psychological and personality constructs (i.e., extroversion, neuroticism, and depression). Additional personality constructs (e.g., curiosity) were also investigated using inter-correlations.

Materials and Apparatus

A computer program written in Microsoft Visual Basic 6.0 was used to present the self-report measures of affect and the personality inventories on IBM compatible computers. The responses for each participant were recorded in an ASCII file using a "comma-space-value" or CSV format. That is to say, a comma in the file separated the response to each item. This allowed the files to be compiled into a large database using another computer program that had been written in Microsoft® QuickBasic® and managed with Microsoft® Excel® and SPSS®.

Development of the Facial-Positive Affect Negative Affect Scales

Initially, 49 judges (26 females and 23 males that ranged in age from 17 to 47) were used to identify items for the Facial Positive Affect Negative Affect Scales (F-PANAS). The judges were enrolled in an introductory psychology course at a regional state university in the Midwest and received credit in partial fulfillment towards a research requirement for that course. The ethnic backgrounds of the judges were 12.3% African American, 3.1% Asian, 81.5% Caucasian, and 3.1% Native American.

The judges were asked to rate a fixed item pool of 47 cartoon facial expressions of emotion that had been generated by the author (see Appendix B). The judges rated expressions using a five-point bipolar Likert-type extent scale with the following categories: very negative, slightly negative, neutral, slightly positive, and very positive (values for responses ranged from −2 to +2, respectively). The average ratings across judges were used to identify 10 positive (i.e., averages closest to +2) and 10 negative (i.e., averages closest to −2) cartoon facial expressions for the positive and negative scales, respectively. Three faces were removed from the negative scale due to redundancy and replaced with the three next lowest rated faces (i.e., closest to −2) to form the F-PANAS (see Appendix A).

The twenty items identified by the judges, after the removal of redundant items, were used to form the F-PANAS. For this study, the responses to the F-PANAS were recorded on a five-point Likert-type extent scale with the following categories: very slightly or not at all, a little, moderately, quite a bit, and extremely (values for the responses ranged from +1 to +5, respectively).

Instrumentation

Positive Affect Negative Affect Schedule. Watson, Clark, and Tellegen's (1988) Positive Affect Negative Affect Schedule (PANAS) consists of two scales containing ten words each (e.g., proud and alert for Positive Affect; jittery and hostile for Negative Affect). When assessing state affect the following instructions were used: "Indicate to what extent you feel this way right now." When assessing trait affect the following instructions were used: "Indicate to what extent you generally feel this way, that is, how you feel on the average". The responses to each word was recorded on a five-point Likert-type extent scale with the following categories: very slightly or not at all, a little, moderately, quite a bit, and extremely (values for the responses ranged from +1 to +5, respectively). The reliabilities for the Positive Affect (PA) and Negative Affect (NA) scales, as reported by Watson and Clark (1994), ranged from .83 to .91 depending on the time frame (e.g., moment, past few weeks, in general). Watson, Clark, and Tellegen (1988) reported low inter-correlations ranging from −.12 to −.23. The factorial validity of the PANAS indicates two scales with simple structure (i.e., the words for each subscale only loaded on one factor, with negative cross-loadings no stronger than .15 on the other factor). The internal consistency for these scales when used in this study ranged from .88 to .89 with test-retest reliabilities for state PA and NA of .52 and .48, respectively, and test-retest reliabilities for trait PA and NA of .77 and.72, respectively. Inter-correlations for PA and NA ranged from −.08 to −.29.

NEO-Five Factor Inventory. Costa and McCrae (1992) developed the NEO-Five Factor Inventory (NEO-FFI) to that target the Big-Five domain scales of Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The internal consistency of these scales as reported by Costa and McCrae, were .89, .79, .76, .74, and .84, respectively. For this study, the internal consistency of scales ranged from .74 to .84 with test-retest reliabilities that ranged from .83 to .91. The Costa and McCrae report that the NEO-FFI scales correlated highly with the Five-Factor (NEO) scales with an average correlation of .77 (.90 if corrected for random error). The instrument contains 60 five-point Likert-type agreement scale items with the following categories: strongly disagree,

disagree, neutral, agree, and strongly agree (values for the responses ranged from 0 to +4, respectively, with the reverse scoring of some items). This study found the internal consistency reliabilities for Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness to be .84, .81, .76, .74, and .84; with test-retest reliabilities of .91, .83, .83, .86, and .90, respectively. Absolute inter-correlations ranged from .05 to .42.

State Trait Personality Inventory (Form Y). Spielberger's (1995) State Trait Personality Inventory (Form Y), referred to as the STPI, has 8 scales measuring Anxiety, Anger, Curiosity, and Depression (each construct has two unique scales; one for state and another for trait). The instrument uses 80 four-point Likert-type frequency scale items (ten items per scale) with the categories; almost never, sometimes, often, and almost always (values for the responses ranged from +1 to +4, respectively, with the reverse scoring of some items). The Coefficient Alpha reliabilities of the scales, as reported by Spielberger, ranged from .80 to .94. For this study, the reliabilities of the scales ranged from .81 to .90. Test-retest reliabilities for the STPI in this study ranged from .34 to .67 and .77 to .88 for state and trait constructs, respectively. The trait Depression scale of the STPI correlated significantly with the Center for Epidemiologic Studies Depression Scale, the Beck Depression Inventory, and the Self Rating Depression Scale with correlations of .74, .83, and .76, respectively. The STPI scales of Anger, Anxiety, and Curiosity correlated with their respective constructs as measured by the State-Trait Anger, State-Trait Anxiety, and the State-Trait Curiosity Inventories with correlations ranging from .93 to .99.

Procedure

Participants were assigned a confidential number to track their results across two administrations. The confidential ID number was recorded on a data sheet along with the participants' name, date, and time of day. The ID numbers were arranged sequentially in ascending order on the data sheet. Participants were asked to sign an informed consent form in addition to being provided with a copy for the participant's record (see Appendix F). The consent forms also had the ID number recorded on it, and were filed alphabetically. The participant(s) were then seated in front of a computer(s) and asked to view a title screen that displayed the appropriate credits and copyright information regarding the use of the NEO-FFI, STPI, and PANAS contained in the program. A password was also included in the computer program to prevent unauthorized access. The computer program then required an ID number that was used as a filename to store the information. The computer program then asked the participant if they had read and signed the consent form (a confidential ID number had already been entered into the computer by the researcher). At this time, the researcher also reminded the participants the importance of reading the instructions that would be presented on the computer screen - emphasizing the importance of how the question was asked in reference to "how you feel right now" versus "how you feel in general." The participants were also instructed to avoid indicating a response too rapidly in order to avoid answering a question without first reading it. If a participant indicated that he/she had read and signed a consent form, the computer randomly assigned the presentation of the instruments to avoid an order effect. The items for the F-PANAS and PANAS were also randomly sequenced while the item-order for the NEO-FFI and the STPI were presented consistently with the paper and pencil versions.

The F-PANAS and PANAS were presented to the participants twice (randomly with the other instruments) to measure the state and trait characteristics of positive and negative affect. For the state measurement the following instructions were used: "Indicate to what extent you feel this way right now." For the trait measurement, the following instructions were used: "Indicate to what extent you generally feel this way, that is, how you feel on the average". At the end of the task, the computer prompted the participants for their age, gender, and ethnic background. The participants then viewed a "thank you" screen and were asked to contact the researcher at which time they were given a "credit" and thanked for their contribution. The participants were also encouraged to return for a second appointment after a minimum of two weeks had passed.

Analyses

As a psychometric study, the analyses regarding the alternative items (i.e., cartoon facial expressions of emotion) contained in the F-PANAS focused on the issues of reliability and validity. Specifically, the reliability of the items were investigated by examining the correlation of an item with its respective scale and the amount of variance of an item that was accounted for by the components retained in a subsequent principal component analyses (i.e., communalities or $h^2$). Coefficient Alpha was used as an indication of the scales' internal consistency reliability while the stability of the F-PANAS was investigated with test-retest reliability coefficients.

The test-retest reliabilities were also used as an indication of validity because the F-PANAS was administered with state and trait instructions (i.e., how you feel right now versus in general, respectively); where state affect was expected to fluctuate as compared to trait affect. Principal component analyses were also used for indications of validity while exploring the structure of the F-PANAS. Convergent and discriminant validity were examined through the use of Campbell and Fiske's (1959) multitrait-multimethod matrix. The matrix includes the F-PANAS as it relates to the Watson, Clark, and Tellegen's (1988) PANAS instrument that uses words as descriptors of emotion. Other measures of mood and personality (i.e., the NEO and STPI) were included to provide initial investigations into the relation of the F-PANAS with other psychological constructs (e.g., openness, anger, and curiosity).

# Chapter 4
# Results

This chapter represents a review of the psychometric properties of the Facial-Positive Affect Negative Affect Scales (F-PANAS) when used to measure state and trait affect. This includes the descriptive statistics, examinations of reliability and validity, and the relation of the F-PANAS with other psychological constructs. In particular, the F-PANAS was compared with Watson, Clark and Tellegen's (1988) Positive Affect Negative Affect Schedule (PANAS) to provide convergent and discriminant validity for the development of the F-PANAS. The F-PANAS and the PANAS are identical with the exception that the F-PANAS utilizes cartoon facial expressions of emotion rather than words to represent affect.

## Reliability Analyses

The reliability of the F-PANAS was observed in three ways. First, an item analysis was conducted to identify weak or poor items for removal (thereby increasing the reliability of the scale after the item was removed). Second, the internal consistency reliabilities of the PA and NA scales, when assessing state and trait affect, were evaluated using Coefficient Alpha. Third, test-retest reliabilities (or estimation of temporal stability) were computed.

Item Analysis of the F-PANAS. Item analyses for the PA and NA scales of the F-PANAS when assessing state and trait affect were conducted to identify poor or weak items within the scales from the perspective of content homogeneity. A summary of these analyses are presented in Table 1 and Table 2 for the PA and NA scales, respectively. All of the items have moderate or high correlations with their scale score, and the removal of any item would *reduce* the reliability of the scale with the exceptions of items 9 and 10 (i.e., face 9 and 10) from the PA scale. Item 9 has moderate to low correlations of .42 and .33 with state and trait PA, respectively; but removing item 9 would not increase (or decrease) the reliabilities. Item 10 had low correlations of .27 and .31 with state and trait PA, respectively, but removing item 10 would increase the reliability by only .01 of the state assessment of PA and would not increase (or decrease) the reliability of the trait assessment of NA. In short, while the low to moderate correlations of items 9 and 10 are indications of weak items, retaining or removing them has little or no effect on the internal consistency reliability of the PA scale.

Table 1

Item Analysis for the PA Scale of the F-PANAS when Assessing State and Trait Affect

| | State | | Trait | |
|---|---|---|---|---|
| Item | Corrected Item-Total Correlation | Alpha if Deleted | Corrected Item-Total Correlation | Alpha if Deleted |
| Face 1 | .68 | .85 | .54 | .80 |
| Face 2 | .69 | .85 | .57 | .79 |
| Face 3 | .64 | .85 | .59 | .79 |
| Face 4 | .72 | .84 | .54 | .80 |
| Face 5 | .64 | .85 | .64 | .79 |
| Face 6 | .63 | .85 | .55 | .80 |
| Face 7 | .55 | .86 | .49 | .80 |
| Face 8 | .60 | .85 | .48 | .80 |
| Face 9 | .42 | .87 | .33 | .82 |
| Face 10 | .27 | .88 | .31 | .82 |
| Alpha for All 10 Items | | .87 | | .82 |

Note. Scale development sample, $n = 375$.

Table 2

Item Analysis for the NA Scale of the F-PANAS when Assessing State and Trait Affect

| | State | | Trait | |
|---|---|---|---|---|
| Item | Corrected Item-Total Correlation | Alpha if Deleted | Corrected Item-Total Correlation | Alpha if Deleted |
| Face 11 | .77 | .93 | .67 | .91 |
| Face 12 | .83 | .93 | .75 | .90 |
| Face 13 | .74 | .93 | .66 | .91 |
| Face 14 | .84 | .93 | .74 | .90 |
| Face 15 | .78 | .93 | .66 | .91 |
| Face 16 | .74 | .93 | .69 | .91 |
| Face 17 | .68 | .93 | .63 | .91 |
| Face 18 | .73 | .93 | .68 | .91 |
| Face 19 | .72 | .93 | .72 | .91 |
| Face 20 | .63 | .94 | .68 | .91 |
| Alpha for All 10 Items | | .94 | | .92 |

Note. Scale development sample, $n = 375$.

Internal Consistency Reliabilities of the F-PANAS. Coefficient Alpha, a measure of internal consistency reliability, was computed for each of the F-PANAS scales when used with the instructions; "How you feel RIGHT NOW" (i.e., state affect) and "How you feel in GENERAL" (i.e., trait affect). The internal consistency reliabilities can be found in Table 3 and range from .82 to .94. These high reliabilities are also a strong indication of construct validity and will be referenced again in the section regarding the validity analyses for the F-PANAS.

Table 3

Internal Consistency and Test-Retest Reliability Coefficients for the F-PANAS

| | State | | Trait | |
|---|---|---|---|---|
| F-PANAS | Internal Consistency | Test-Retest Reliability | Internal Consistency | Test-Retest Reliability |
| PA | .87 | .39 | .82 | .77 |
| NA | .94 | .49 | .92 | .70 |

Note. Scale development sample, $n = 375$.

Test-Retest Reliability. The test-retest reliabilities (or temporal stability) for the F-PANAS were also presented in Table 3. Participants completed the computer assessment a second time after a minimum of two weeks had passed. [Note. The minimum and maximum time span between tests were 16 and 77 days, respectively, with an average of 44 days plus or minus 15 days.] When assessing state affect, the test-retest reliabilities were lower for the PA and NA scales compared to the higher test-retest reliabilities of the PA and NA scales when assessing trait affect. Due to the nature of state and trait affect, these results are also an indication of construct validity that will be discussed in greater detail elsewhere.

Validity Analyses

To investigate the validity of the F-PANAS, a multitrait-multimethod matrix (Campbell & Fiske, 1959) was used along with two principal component analyses (one for state and another for trait). The multitrait-multimethod matrix provides information regarding the convergent and discriminant validity of the F-PANAS, which uses facial expressions, when compared with the PANAS, which uses words. The principal component analyses evaluated the structural validity of the F-PANAS in addition to providing a secondary source of information regarding the identification of weak items (see the previous section in the reliability analyses regarding item analysis).

Descriptive Statistics. The first step was to investigate for gender differences on the F-PANAS. A multivariate examination of the scales, when assessing state and trait affect, was used to test for significant differences between males and females. Using Wilks' lambda, the multivariate combination of the scales did not reveal a significant difference between genders, $F(4, 370) = .11, p > .97$. For the descriptive statistics presented in Table

4, there were no significant gender differences on the Positive Affect (PA) and Negative Affect (NA) scales of the F-PANAS. Participants did score higher on PA compared to the lower NA scores; $F(1, 373) = 692.85, p < .001$ ($\omega^2 = .45$), and the state affect scores were lower than the trait affect scores; $F(1, 373) = 190.90, p < .001$ ($\omega^2 = .02$). These results are consistent with previous studies that utilized the PANAS (Watson et al,., 1988, Watson and Clark, 1994).

Table 4

F-PANAS Means, Standard Deviations, and *t*-tests for Gender

| State | *M* | *S.D.* | *t* |
|---|---|---|---|
| Positive Affect | 27.84 | 7.80 | |
| Males | 28.00 | 8.21 | .28 |
| Females | 27.77 | 7.60 | |
| Negative Affect | 14.63 | 7.28 | |
| Males | 14.45 | 7.17 | −.34 |
| Females | 14.72 | 7.34 | |
| **Trait** | | | |
| Positive Affect | 31.54 | 6.27 | |
| Males | 31.50 | 6.48 | −.07 |
| Females | 31.55 | 6.18 | |
| Negative Affect | 17.00 | 6.93 | |
| Males | 17.06 | 6.90 | .11 |
| Females | 16.98 | 6.96 | |

Note. Scale development sample, $n = 375$ (123 males; 252 females).

Convergent and Discriminant Validity. Campbell and Fiske (1959) introduced a technique of investigating convergent and discriminant validity using what they refer to as the multitrait-multimethod matrix that is provided in Table 6. Cartoon facial expressions of emotion in the F-PANAS and affect terms or words in the PANAS were the two methods used to assess state and trait aspects of PA and NA. These two methods and four psychological constructs (i.e., "traits") form the multitrait-multimethod matrix. Internal consistency reliability coefficients are contained in parentheses and form the reliability diagonals (also referred to as the monotrait-monomethod values). For the F-PANAS, these are the same internal consistency reliability coefficients presented earlier. These high reliability coefficients (ranging from .82 to .94) are presented here again to emphasize the importance of internal consistency reliability as a necessary, but not sufficient, component of construct validity.

Below the reliability diagonals are the heterotrait-monomethod triangles (enclosed with solid lines). A reliability diagonal and heterotrait-monomethod triangle form a monomethod block. In Table 9, the two monomethod blocks containing the reliability diagonals for each method and the heterotrait-monomethod triangles are found in the upper left and lower right of the matrix. In the lower left corner of the matrix, a heteromethod block is formed by a validity diagonal (in italics) that is surrounded by two heterotrait-heteromethod triangles (enclosed with dashed lines).

Table 5

Multitrait-Multimethod Matrix for the F-PANAS and PANAS

| Multi-Method | Multitrait | F-PANAS (Facial Expressions) S-PA | F-PANAS S-NA | F-PANAS T-PA | F-PANAS T-NA | PANAS (Words) S-PA | PANAS S-NA | PANAS T-PA | PANAS T-NA |
|---|---|---|---|---|---|---|---|---|---|
| F-PANAS | S-PA | (.87) | | | | | | | |
| | S-NA | −.16 | (.94) | | | | | | |
| | T-PA | .63 | −.09 | (.82) | | | | | |
| | T-NA | −.07 | .67 | −.05 | (.92) | | | | |
| PANAS | S-PA | *.53* | −.20 | .40 | −.18 | (.89) | | | |
| | S-NA | −.11 | *.68* | −.08 | .52 | −.08 | (.88) | | |
| | T-PA | .46 | −.21 | *.47* | −.26 | .70 | −.21 | (.88) | |
| | T-NA | −.09 | .48 | −.13 | *.67* | −.19 | .56 | −.29 | (.88) |

Note. Scale development sample, $n = 375$. S = state; T = trait; PA = Positive Affect; NA = Negative Affect.

Campbell and Fiske (1959) list the following four aspects of the multitrait-multimethod matrix that are indicators of convergent and discriminant validity:

1. the validity diagonal should be significantly different from zero
2. a validity diagonal value should be higher than the value lying in its column and row in the heterotrait-heteromethod triangles
3. a variable correlates higher with an independent effort to measure the same trait than with measures designed to get at different traits that use the same method
4. the same pattern of trait interrelationship be shown in all of the heterotrait triangles of both the monomethod and heteromethod blocks (p. 82-83).

Since the values in the validity diagonal of Table 5 are significantly different from zero, with values ranging from .47 to .68, convergent validity is supported. In addition, each value in the validity diagonal is the highest value in its row or column (indicating discriminant validity). Campbell and Fiske's (1959) third criterion is often not met, as is the case here. That is to say, with the exception of the validity coefficient for state-Negative Affect (S-NA), values greater or equal to the validity coefficients can be found in the heterotrait triangles in each of the monomethod blocks. For example, the validity coefficient for S-PA (i.e., .53) is less than the coefficients of S-PA with *other* traits using the same method (i.e., .63 and .70 from the F-PANAS and PANAS monomethod blocks, respectively). This indicates, for example, that measuring S-PA and T-PA is more closely related than measuring S-PA with two different methods. Stated another way, the distinction between state and trait affect across methods is not as great as we would like - which is often the case. This is "typical of the usual case with individual differences research" and will be discussed later (Campbell & Fiske, 1959, p. 83). The highly consistent pattern of both the magnitude and sign (+ / −) of the coefficients across the heterotrait-monomethod and heterotrait-heteromethod triangles satisfied the last of Campell and Fiske's criteria.

Structural Validity of the F-PANAS. The structure of the F-PANAS, when used to assess both state and trait affect, was investigated by utilizing two principal component analyses (one for state and one for trait). The first step in conducting a principal component analysis is to ensure that the data meet the criteria for the statistical procedure. The chi-square distribution is used by Bartlett's test of sphericity to see if the correlation matrix, produced by the F-PANAS items, is an identity matrix (i.e., a matrix that has 1's along the diagonal and 0's in the off-diagonals). [Note. An identity matrix indicates that the variables are unrelated and that there are no underlying constructs (i.e., components or factors).] The rejection of the null hypothesis of Bartlett's test is minimal evidence for the appropriateness of a structural analysis. For the F-PANAS, the chi-squares for Bartlett's test of sphericity were 4403.32 (190, N = 375), $p < .001$ and 3217.36 (190, N = 375), $p < .001$ when assessing state and trait affect, respectively.

A second statistic, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, takes the ratio of the sum of squared correlations over the sum of squared correlations plus the sum of squared partial correlations. A KMO greater than .60 indicates a valid analysis can be accomplished using principal components (Tabachnick & Fidell, 1989) while anything less than .40 is unacceptable (Hatcher, 1994). For the F-PANAS, the KMOs were .93 and .90 when assessing state and trait affect, respectively. Taking into account that Bartlett's tests of sphericity were significant and that Kaiser (1974) considers KMO's in the .90's as marvelous, the data gathered using the F-PANAS in this study were deemed adequate for principal component analyses.

Deciding on the number of components to retain is the next step in the process of conducting a principal component analysis. The goal of a good solution is to retain meaningful components, without over- or underextracting, that account for a large proportion of the variance. Underextraction fails to identify potentially important components while overextraction can build up or overemphasize minor ones. Either under- or overextraction will produce solutions that are oversimplified or difficult to interpret and replicate.

Table 6

Eigenvalues ($\phi$) and Amount of Variance Accounted For

| | State | | | Trait | | |
|---|---|---|---|---|---|---|
| Component | $\phi$ | % Variance Explained | Cumulative % | $\phi$ | % Variance Explained | Cumulative % |
| 1 | 7.06 | 35.30 | 35.30 | 5.96 | 29.81 | 29.81 |
| 2 | 4.33 | 21.66 | 56.96 | 3.86 | 19.28 | 49.09 |
| 3 | 1.06 | 5.29 | 62.25 | 1.18 | 5.91 | 55.00 |
| 4 | 0.94 | 4.72 | 66.97 | 1.01 | 5.07 | 60.07 |
| 5 | 0.73 | 3.64 | 70.61 | 0.84 | 4.21 | 64.28 |
| 6 | 0.69 | 3.43 | 74.04 | 0.79 | 3.96 | 68.23 |
| 7 | 0.66 | 3.28 | 77.32 | 0.71 | 3.54 | 71.77 |
| 8 | 0.56 | 2.79 | 80.11 | 0.63 | 3.14 | 74.91 |
| 9 | 0.50 | 2.51 | 82.62 | 0.60 | 3.01 | 77.92 |
| 10 | 0.46 | 2.32 | 84.94 | 0.56 | 2.81 | 80.73 |
| 11 | 0.42 | 2.12 | 87.06 | 0.52 | 2.58 | 83.31 |
| 12 | 0.40 | 2.02 | 89.08 | 0.49 | 2.46 | 85.77 |
| 13 | 0.35 | 1.74 | 90.81 | 0.46 | 2.31 | 88.07 |
| 14 | 0.32 | 1.61 | 92.43 | 0.43 | 2.14 | 90.21 |
| 15 | 0.30 | 1.48 | 93.91 | 0.40 | 1.99 | 92.21 |
| 16 | 0.29 | 1.44 | 95.35 | 0.36 | 1.79 | 94.00 |
| 17 | 0.27 | 1.35 | 96.70 | 0.35 | 1.75 | 95.74 |
| 18 | 0.24 | 1.22 | 97.92 | 0.32 | 1.60 | 97.34 |
| 19 | 0.22 | 1.09 | 99.01 | 0.29 | 1.46 | 98.80 |
| 20 | 0.20 | 0.99 | 100.00 | 0.24 | 1.20 | 100.00 |

Note. Scale development sample, $n = 375$.

There are two approaches to using the proportion of variance accounted for to identify the number of components to retain. The first technique would be to require a component to account for a minimum amount of variance. Using this approach with a 10% minimum, two components from Table 6 would be retained within the F-PANAS when assessing state or trait affect. The second approach requires retaining enough components to account for a specific total percentage of the variance. Applying a criteria of 60% to Table 6 would lead us to retain three components for the F-PANAS when assessing state affect and four components when assessing trait affect. After the second component however, each component is only accounting for less than 6% of the total variance.

Another common method, and typically the default in large statistical packages, is to retain components that have an eigenvalue greater than one, referred to as the Kaiser criterion or K1 rule (Zwick & Velicer, 1986). Using Table 6 and the K1 rule, three components would be retained for the F-PANAS when assessing state affect and four components when assessing trait affect. However, the third and fouth components only account for a small amount of the total variance. It should be noted that Zick and Velicer (1986) found the K1 rule would consistently overestimate, but never underestimate, the number of factors.

Cattell's (1966a) scree test is a third method for retaining components that graphs the eigenvalues from Table 6 and is referred to as a scree plot (as seen in Figures 2 and 3). A straight line is drawn through the smaller values (i.e., the scree or rubble) and the components with eigenvalues above the line are retained. A single clear break, or large reduction in eigenvalues, is found in both Figures 2 and 3 after the second component. This drastic reduction between the second and third component is nearly a four to one ratio in both scree plots and indicates that there are only two potentially meaningful components worth retaining.

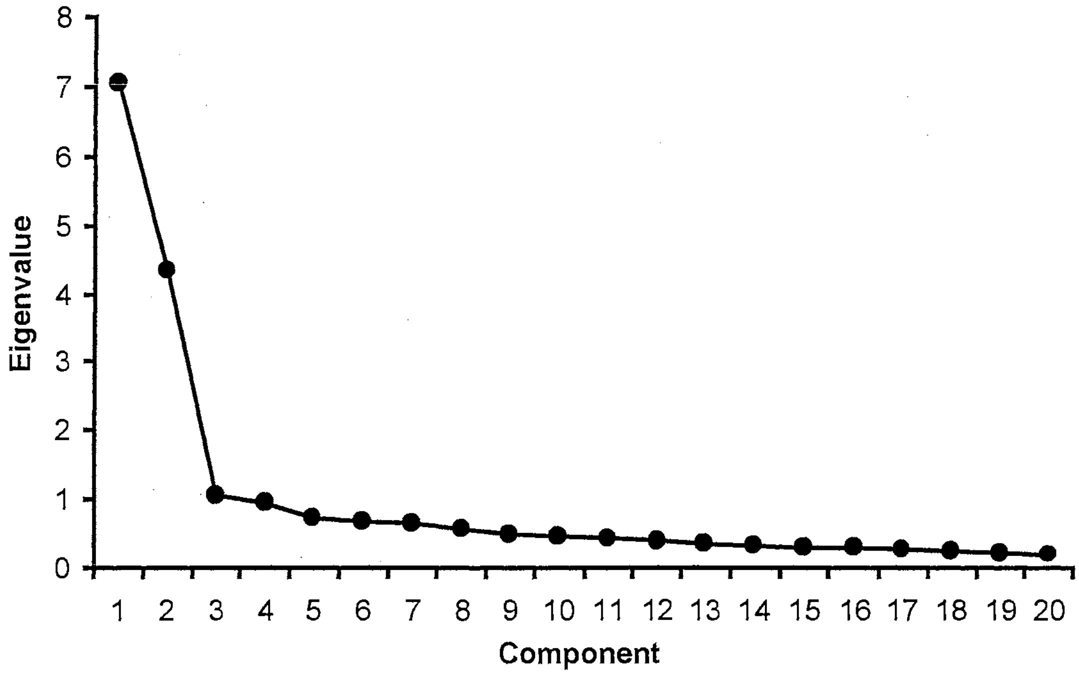


Figure 2. Scree plot for the Analysis of State Affect using the F-PANAS.

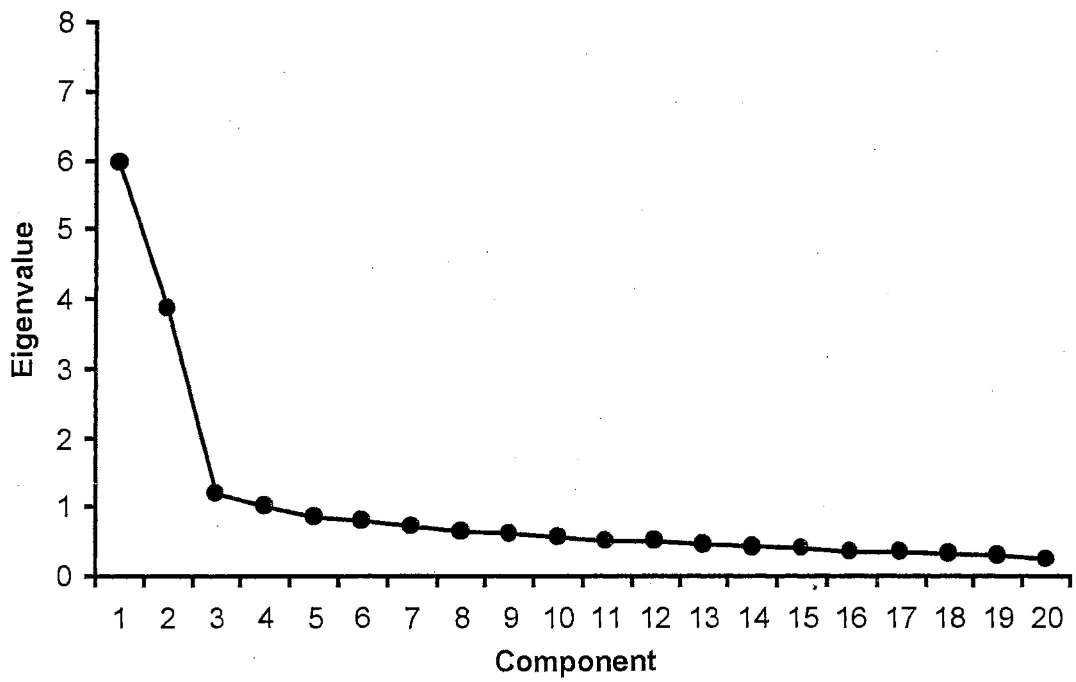


Figure 3. Scree plot for the Analysis of Trait Affect using the F-PANAS.

The three methods of retaining components (proportion of variance, K1, and the scree test) vary in their degree of accuracy as the sample size and communalities ($h^2$) rise and fall. It has been reported that the proportion of variance, and especially the K1 rule, consistently overextract the number of components. Hamlin and Coombs (1998) found that the scree test outperformed the K1 rule when the sample size was 400 and the communalities averaged at least .30. Stevens (1996) recommends using the K1 rule when $N > 250$ and the average communality is $\geq .60$ or the scree test if $N > 200$ and the communalities are reasonably large.

Hatcher (1994) lists several characteristics that indicate if a reasonable solution has been reached that is determined by the solution's interpretability:

1. at least 3 variables with significant loading on each retained component
2. the items that load on a given component share the same conceptual meaning
3. variables that load on different components seem to measure different constructs
4. the rotated solution demonstrates simple structure (i.e., items only load on one factor) (p. 26-27).

Guadagnoli & Velicer (1988) found that retained components, regardless of sample size, were reliable if each component had four or more items with loadings greater than $|.60|$.

Two factors that were identified within state affect were also identified within trait affect. These factors were extracted using principal axes with a varimax rotation. This orthogonal solution was chosen after an oblique solution (one that allows the factors to correlate during the rotation) indicated independence of the factors ($r = -.19$ for state affect and $r = -.10$ for trait affect). [Note. correlations between PA/NA were −.16 and −.05 for state and trait, respectively.] With the exception of Face 10, items from the F-PANAS had good communalities with component loadings greater than .40 only on one factor (see Table 7). Face 10 had weak communalities of .13 and .17 when assessing state and trait affect, respectively. These results indicated a simple two-factor solution for both state affect and trait affect. Furthermore, given the clear visual pattern in the scree plots and the theoretical model underlying the scales, two component solutions are considered ideal.

Table 7

F-PANAS: Varimax Rotated Solutions for Assessing State and Trait Affect with Component Loadings and Communalities ($h^2$)

| | State | | | Trait | | |
|---|---|---|---|---|---|---|
| Variables | NA | PA | $h^2$ | NA | PA | $h^2$ |
| Face 1 | | .74 | .65 | −.36 | .65 | .55 |
| Face 2 | | .77 | .62 | | .69 | .49 |
| Face 3 | | .72 | .54 | | .71 | .50 |
| Face 4 | | .80 | .64 | | .66 | .44 |
| Face 5 | | .70 | .58 | | .74 | .59 |
| Face 6 | | .71 | .51 | | .65 | .42 |
| Face 7 | | .66 | .43 | | .60 | .36 |
| Face 8 | | .70 | .50 | | .59 | .36 |
| Face 9 | | .56 | .40 | | .46 | .27 |
| Face 10 | | .35 | .13 | | .41 | .17 |
| Face 11 | .82 | | .68 | .73 | | .53 |
| Face 12 | .87 | | .75 | .81 | | .66 |
| Face 13 | .79 | | .64 | .73 | | .53 |
| Face 14 | .87 | | .76 | .80 | | .64 |
| Face 15 | .82 | | .68 | .73 | | .53 |
| Face 16 | .79 | | .63 | .75 | | .57 |
| Face 17 | .73 | | .54 | .70 | | .49 |
| Face 18 | .78 | | .61 | .74 | | .55 |
| Face 19 | .76 | | .61 | .77 | | .60 |
| Face 20 | .71 | | .50 | .75 | | .57 |
| Rotational Sum of Squares Loadings | 6.69 | 4.70 | | 5.91 | 3.91 | |
| Total Variance | .35 | .22 | | .30 | .20 | |
| Common Variance | .59 | .41 | | .60 | .40 | |

Note. Scale development sample, $n = 375$. Absolute values for component loadings below .30 were not used to interpret the components and were removed for clarity. PA = Positive Affect; NA = Negative Affect.

Relation of the F-PANAS with other Psychological Constructs

Correlations of the F-PANAS with other psychological constructs were also analyzed to provide initial validity information regarding the development of the F-PANAS. These instruments included (1) the NEO-Five Factor Inventory (NEO-FFI) that measures Neuroticism , Extraversion, Openness, Agreeableness, and Conscientiousness and (2) the State Trait Personality Inventory (STPI) that contains eight scales that measure both the state and trait characteristics of Anger, Curiosity, Anxiety, and Depression.

Table 8

Correlation Matrix for the F-PANAS with the NEO-FFI

| | NEO-FFI | | | | | |
|---|---|---|---|---|---|---|
| F-PANAS | N | E | O | A | C | R† |
| S-PA | −.23 | .38 | .05 | .15 | .18 | .39 |
| S-NA | .35 | −.28 | −.04 | −.31 | −.22 | .43 |
| T-PA | −.22 | .35 | .15 | .16 | .17 | .38 |
| T-NA | .46 | −.31 | −.02 | −.31 | −.32 | .52 |

Note. Scale development sample, $n = 375$. S = state; T = trait; PA = Positive Affect; NA = Negative Affect, N = Neuroticism, E = Extroversion; O = Openness; A = Agreeableness; C = Conscientiousness.
† this is a correlation using a linear combination of the NEO-FFI subscales

Table 9

Correlation Matrix for the F-PANAS with the STPI State Subscales

| | STPI | | | | |
|---|---|---|---|---|---|
| F-PANAS | S-Anxiety | S-Curiosity | S-Anger | S-Depression | R† |
| S-PA | −.25 | .37 | −.16 | −.36 | .43 |
| S-NA | .56 | −.19 | .66 | .60 | .72 |
| T-PA | −.15 | .29 | −.11 | −.25 | .32 |
| T-NA | .49 | −.14 | .51 | .49 | .59 |

Note. S = State; T = Trait; PA = Positive Affect; NA = Negative Affect.
† this is a correlation using a linear combination of the STPI state subscales

Table 10

Correlation Matrix for the F-PANAS with the STPI Trait Subscales

| | STPI | | | | |
|---|---|---|---|---|---|
| F-PANAS | T-Anxiety | T-Curiosity | T-Anger | T-Depression | R† |
| S-PA | −.21 | .30 | −.22 | −.29 | .37 |
| S-NA | .43 | −.20 | .34 | .49 | .52 |
| T-PA | −.22 | .32 | −.23 | −.33 | .41 |
| T-NA | .59 | −.24 | .42 | .60 | .65 |

Note. S = State; T = Trait; PA = Positive Affect; NA = Negative Affect.
† this is a correlation using a linear combination of the STPI trait subscales

The patterns presented in Tables 8, 9, & 10 are of importance because the they are close to what would be predicted based on the construct definitions. Positive Affect positively correlates with the positively defined constructs of Extroversion, Openness, Agreeableness, and Conscientiousness from the NEO-FFI and with Curiosity from the STPI. Furthermore, when Positive Affect is related with the negatively defined constructs of Neuroticism from the NEO-FFI and Anger, Anxiety, and Depression from the STPI, negative correlations emerge. The inverse is true when Negative Affect is correlated with positively or negatively defined constructs that produce negative and positive correlations, respectively. These highly consistent and logical patterns of Positive and Negative Affect with positively and negatively defined constructs are another source of validity.

# Chapter 5
# Discussion

The goal of this research was to develop an instrument to measure affect that avoids the complexities of using language as descriptors of emotion. Rather than representing affect with words, cartoon facial expressions of emotion were used as an alternative source of items. Initially - judges identified twenty faces to represent positive and negative affect (ten faces each) to form the Facial-Positive Affect Negative Affect Scales (F-PANAS). These scales were then used to assess state and trait affect (i.e., "You feel this way at the present, that is, how you feel right now" versus "You generally feel this way, that is, how you feel on the average"). The psychometric properties of the F-PANAS, including multiple indicators of reliability and validity, indicated that the instrument (1) has good internal consistency (2) has moderate test-retest reliability when assessing trait affect and (3) has considerable convergent and discriminant validity with other affect and personality constructs. In addition to the interpretation of these findings, this chapter explores the theoretical implications of the study, its limitations, and suggestions for future research.

## Reliability

The reliability of the F-PANAS was assessed for both internal consistency and test-retest reliability. It was found that retaining the initial items for the Positive Affect (PA) and Negative Affect (NA) scales did not significantly diminish the internal consistency reliability coefficients (i.e., Coefficient Alpha) of the scales. These coefficients (see Table 5) were relatively high ranging from .82 to .94 when assessing both state and trait affect. The test-retest reliabilities were also in the moderate to high range (.77 and .70) when measuring PA and NA trait affect (respectively) but relatively low (.34 and .49) for

PA and NA state affect (respectively). Therefore, the test-retest reliabilities indicated that the F-PANAS is stable when measuring trait affect.

To some extent, another source of item reliability was provided by the communalities generated during the structural analyses. Communality is the proportion of variance that the item has in common with *all* of the retained components). If an item has a large communality, most of that item's variance is shared with or accounted for (i.e., in "common") by the retained components. Therefore, as the amount of variance increases that an item has in common with the retained components (i.e., the higher the communality) - the higher the item's reliability. According to Crocker and Algina (1986), using communalities as an indication of item reliability provides a lower bound estimate. The lower bound estimates (i.e., communalities) presented earlier in Table 7 are moderate to high - indicating good item reliability for both scales of the F-PANAS when assessing state or trait affect.

Validity

Several methods were utilized to examine the validity of the F-PANAS scales. These included structural analyses, convergent/discriminant validity, and the relations of the F-PANAS scales with other constructs. The results of the reliability analyses, as previously discussed, also shed some light on the validity of the constructs.

Temporal Stability of the Constructs. Testing a construct at two unique points in time, also referred to as test-retest reliability, can assess temporal stability. Due to the nature of state and trait affect, the test-retest reliabilities from the current study provided some evidence of validity. Specifically, the temporal stability (i.e., test-retest reliability) of the F-PANAS when assessing trait affect was relatively high compared to the low temporal stability when assessing state affect. Given the nature of the constructs (i.e., state and trait), one would expect temporal stability differences. That is to say - one would expect state affect to fluctuate and be less related as time between observations increased (e.g., because you are manic right now does not necessarily mean that you will be manic seven days from now). Trait affect, on the other hand, by definition, should be a stable construct that is strongly related to different observations regardless of the amount of time that has passed. This pattern of test-retest reliabilities therefore, in addition to providing evidence of temporal stability when assessing trait affect, also provided some support for the construct validity of the F-PANAS.

Structural Analyses of the F-PANAS. Further construct validity of the F-PANAS was provided by structural analyses. Each temporal condition (i.e., state and trait) assessed by the F-PANAS was explored using a principal component analysis, which revealed two underlying components for each temporal condition. The components were identified using Cattell's (1966) scree test as recommended by Stevens (1996). More importantly, a two-component solution is congruent with the theoretical composition of the scales and was considered ideal. In this study, ten items were selected to measure positive affect and ten items were selected to measure negative affect.

Another indication of the solutions' congruency with the instrument's theoretical framework (i.e., construct validity) was seen in the rotation and simple structure of the ***two***-component solutions. An oblique rotation, which allowed the two components to correlate, indicated that the components were relatively independent and that an orthogonal rotation was reasonable. An orthogonal rotation reduces the complexity of interpreting the components because the components are uncorrelated and can be addressed individually. Furthermore, the structure of the orthogonal solution was relatively simple. Not only did the items load relatively high on only one component, but the PA items strongly loaded only on the PA component and the NA items strongly loaded only on the NA component (see Table 7). The criteria used to interpret the principal component analyses including the number of components, the independence of the components, and the simple structure of the solutions, fit the theoretical framework of the scales and were strong indicators of construct validity.

Convergent and Discriminant Validity. A variety of means were used to assess the convergent and discriminant validity of the F-PANAS by relating its scores to other measures of emotion and personality. The multimethod-multitrait matrix, a method developed by Campbell and Fiske (1959), was used to compare subscales from the F-PANAS and the PANAS. The PANAS uses a word as a descriptor of emotion whereas the F-PANAS uses a cartoon facial expression of emotion; but both instruments share a theoretical framework. The sophistication and difficulty of investigating convergent and discriminant validity with this method often leads to less than desirable results (i.e., major deterrents that keep this method from being used more often). Because the F-PANAS faired so well under the stringent criteria of the multitrait-multimethod matrix, the results using this method are considered to be a source of strong evidence regarding the convergent and discriminant validity of the instrument in relation to other constructs.

As a *minor* distraction from the issues of validity, higher correlations were found between state and trait PA within each of the monomethod triangles (ranging from .56 to .70) compared to the slightly lower state or trait PA validity coefficients (.53 or .47). This is a distraction because the validity coefficients that represent the same construct measured by different methods should be relatively higher than the coefficients of different constructs measured with the same method. A possible explanation is that a response set can manifest itself within a method of assessment and increase the correlations between traits due to shared method variance or "method covariance". In addition, the response sets will more than likely differ between methods causing a source of unique variance for each method. Therefore, response sets are also capable of reducing validity coefficients because of the unique variance that is not shared between methods (Campbell & Fiske, 1959). The effect of response sets, or at least the variance unique between methods, can be estimated by examining the relatively lower state/trait PA heteromethod correlations of .46 and .40 compared with the relatively higher monomethod correlations of .63 and .70. This increase is attributed to the common variance produced by the method (i.e., response sets) and not necessarily shared with the constructs. A more likely explanation however, is that the distinction between state and trait PA is not as great as would be preferred.

Another distracter from the validity indicators was the smaller coefficients within the pattern of correlations between PA and NA with Neuroticism and Extroversion. While prior research has found relatively consistent patterns of PA relating to Extroversion and NA relating to Neuroticism; PA has remained relatively independent of Neuroticism as well as NA remaining relatively independent of Extroversion (Costa & McCrae, 1980; Watson & Clark, 1994). While PA and NA, as measured by the F-PANAS, were relatively independent of themselves - each construct seems to share a bipolar relationship with Extroversion and Neuroticism; trait PA correlates −.22 and .35 while NA correlates .46 and −.31 with Neuroticism and Extroversion, respectively (see

Table 8). More importantly, however, were the general findings that the F-PANAS had highly consistent bipolar-correlation patterns with positively and negatively defined constructs. Referring to Tables 8, 9, and 10, that contain the correlations of the F-PANAS with the NEO-FFI, STPI state, and the STPI trait scales, respectively; PA had positive correlations with Extroversion, Openness, Agreeableness, and Conscientiousness from the NEO-FFI and with Curiosity from the STPI while negative relationships were found when these constructs were correlated with NA. The inverse of this pattern occurred when PA and NA were correlated with Neuroticism from the NEO-FFI and Anxiety, Anger, and Depression from the STPI.

It was mentioned previously that the pattern of low and high test-retest reliability coefficients among state and trait affect supported the theoretical nature of the scales. Another pattern of coefficients between the F-PANAS and the STPI is also a reflection of the relationship between state and trait affect and is considered another source of validity. When the F-PANAS was used to assess state affect, PA and NA showed a stronger relationship with the linear combination of STPI *state* subscales than when the F-PANAS was used to assess *trait* affect. The reverse was found when the F-PANAS was used to assess trait affect and related to the linear combination of the STPI trait subscales. In brief, measures of state and trait affect showed a higher degree of relationship within their respective temporal zones when the F-PANAS was related to the STPI.

Additionally, the only notable results of the relation of the F-PANAS with the NEO-FFI and the STPI on a scale-to-scale comparison was the relation of NA with the negatively defined constructs of the STPI; ranging from .34 to .66 (see Tables 9 & 10).

Results of the Item Analyses

Separate item analyses were performed on each of the scales being developed in this study (i.e., NA and PA of the F-PANAS when assessing state and trait affect). Even with high internal consistency reliability and evidence of validity, the item analyses revealed some potential improvements. In addition, the structural analyses of the F-PANAS provided a secondary source to identify items that may need to be revised.

In these analyses there were only two items with notable results. Items (i.e., faces) 9 and 10 of the F-PANAS were the only items that did not contribute substantially to the internal consistency of the instrument. As it stands, the potential ambiguity of these items does not distract much from the reliability or validity of the instrument. Referring back to Table 1, Item 9 had moderate item-total correlations of .42 and .33 when used to assess state or trait affect, respectively. However, removing Item 9 from the PA scale did not increase (or decrease) the scale's internal consistency. This is an indication that Item 9 is not a strong contributor to the overall consistency of the scale. The relatively moderate loadings (.56 and .46) for Item 9 from the structural analyses were presented in Table 7 along with the relatively moderate to low communalities (.40 and .27). While Item 9's performance was not disappointing enough to warrant revision, it should be closely reviewed in future research. Item 10's performance however, while not distracting from the internal consistency of the scale, may warrant revision of the item.

Item 10 had low item-total correlations of .27 and .31 with the PA scale when assessing state and trait affect, respectively. Removing Item 10 from the PA scale increased Coefficient Alpha minimally by .01 or had no effect when assessing state and trait affect, respectively. In the structural analyses, Item 10 had relatively moderate loadings (.35 and .41) but relatively weak communalities (.13 and .17). Post analysis examination of Item 10 revealed several characteristics that could be revised. Referring to Appendix A that contains the items for the F-PANAS, it should be noted that Item 10 could represent a negative expression of arrogance or maliciousness rather than a confident or fanciful expression. Potential revisions of Item 10 should not focus on the eyes or eyebrows due to their significant contribution to the facial expression where alteration would result in a new item rather than a revised one. Instead, the line of the mouth could be extended in a strait fashion or centering a slight symmetrical smile would create more of an expression of confidence (i.e., which should result in a reduction of ambiguity by the increase in the representation of positive affect).

Theoretical Implications

An old debate dating back to the late 1960's has currently been raging in the literature regarding the issue of the independence or bipolarity of positive and negative affect. The results of this research are unique in that, initially, the items for the F-PANAS were identified using a bipolar scale. After the items had been selected, the items were then used to assess PA and NA with unipolar Likert scales, because using a bipolar scale to test the independence of PA and NA may force bipolarity onto the results (Russell & Carroll, 1999a). Yet PA and NA remained relatively independent with weak to near zero correlations of −.05 and −.16 when assessing state and trait affect, respectively.

However, another estimation of this independence can be examined without the influence of method covariance (mentioned earlier). By inspecting the heterotrait-heteromethod triangles from Table 5, we find correlations between PA and NA equal to

−.11 and −.13 when assessing state and trait affect, respectively. The pattern of relatively weak to near zero correlations, without the influence of covariance due to using the same method, also indicates that the constructs of positive and negative affect are relatively independent. This independence was again supported using a third source after an oblique rotation during principal component analyses revealed the components representing PA and NA were weakly correlated.

During the initial investigation of the structure of the F-PANAS, an oblique solution with a Promax rotation (Kappa = 4) was used. A Promax rotation begins with orthogonal components (i.e., components that were forced to be uncorrelated initially by the principal component analyses), and then relaxes the assumption of orthogonality (i.e., independence) by raising the loadings on the components by a factor of Kappa. Hendrickson and White (1964) found that using Kappa equal to four generally provided a good solution *if* the underlying components were related. The oblique solution revealed that the relation between the components was relatively weak with PA/NA correlations of −.19 and −.10 when assessing state and trait affect, respectively. Because the oblique solution indicated independence, an orthogonal solution (i.e., varimax rotation) was used. In Chapter Four, the independence of these structures was reported; whereas here, the results were examined in such a way as to allow the possibility of a correlated structure.

Three sources were explored above that investigated the independence of PA and NA; unit score correlations within the F-PANAS, unit score heteromethod correlations between the F-PANAS and the PANAS, and the component correlations produced by an initial oblique solution. Regardless of their origin, these correlations all indicate that PA and NA are relatively independent with low to near zero correlations; strong indications of the independence between PA and NA.

According to Russell (1980), a unipolar dimension (activation) and a bipolar dimension (pleasantness-unpleasantness) create a circular pattern of bipolar opposites (i.e., a circumplex). However, it would be logical to require two bipolar dimensions in order to create this circumplex of emotions. Referring back to Figure 1, as you move around the circle away from pleasantness, the bipolarity of that dimension begins to mix with the unipolar dimension of activation, contaminating the bipolarity, thus reducing or attenuating any relation between the supposedly bipolar opposites - a possibility why researchers are often vexed in their attempts to find bipolar descriptors of emotion. That is to say, as one moves away from the bipolar dimension, the descriptors of emotion become more independent. A second problem arises, referring to Figure 1, when approaching the poles of the dimension of activation. There are few descriptions of emotion to describe the theoretical experience of pure activation or deactivation. This is represented by the grayed areas in Figure 1. The third problem, and a source of major debate between the two models of Russell (1980) and Watson and Tellegen (1985), exists with the rotated dimensions of positive and negative affect with the poles in the deactivated hemispheres labeled with counterintuitive connotations to affect. A conceptual re-organization of the models proposed by Russell (1980) and Watson and Tellegen (1985) is presented in Figure 4.

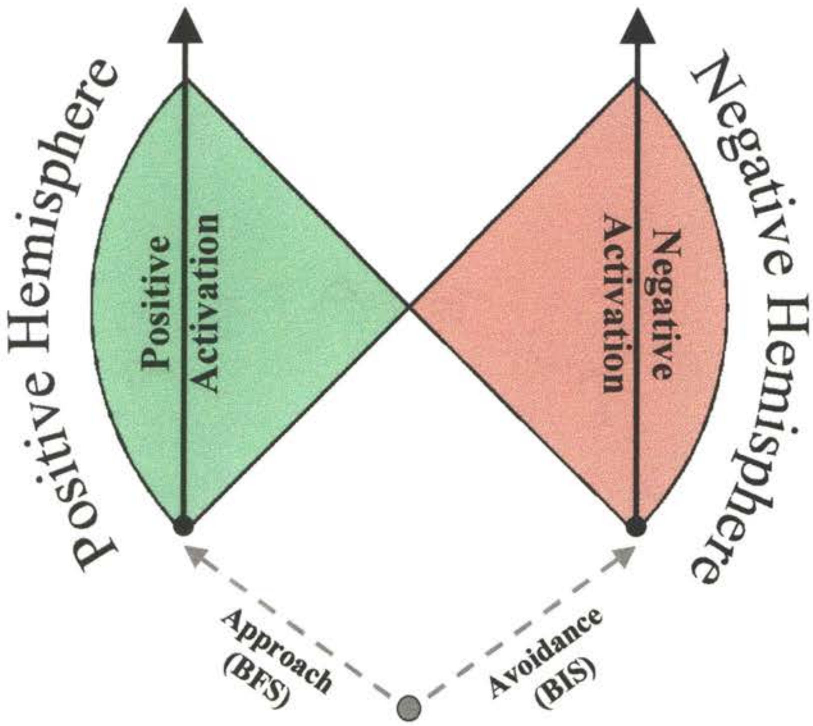


Figure 4. Theoretical Model of Emotions.

The model of emotions presented in Figure 4 reflect an integration of Russell's (1980) circumplex and Watson and Tellegen's (1985) "alternative" model of emotion. The grayed areas from Figure 1 have been removed due to the lack of emotions that are represented in those regions. Watson and Tellegen (1999) suggested that positive and negative affect should only be used to refer to any positive or negative emotional states, and yet renamed their dimensions as positive and negative activation (Watson et al., 1999). However, their dimensions still crisscross into the positive and negative hemispheres with low activation poles of negative and positive, *respectively*! Reorganizing these two models, represented in Figure 4, still emphasizes the role of activation but creates parallel dimensions of activation within each of the hemispheres.

Limitations

This sample was not randomly drawn from a well-defined population (i.e., it was a sample of convenience). Some participants were fulfilling a course requirement while other participants received extra credit as an incentive. Because this study used a sample of convenience, the ability to generalize these results is an empirical matter that requires further testing. A second limitation was related to the solicitation of the sample that resulted in a test-retest time span that varied. After participants received credit for their participation, they were encouraged to return for a second appointment. The length of time between appointments was not set and varied from 16 to 77 days. Since the passage of time influences the correlation between temporal measures of state affect, a fixed time span should be used which is long enough to negate any memory effects (e.g., 42 days). The limitations regarding the population validity and test-retest reliability, therefore, must be taken into account.

Another limitation of this study was the use of a fixed item pool. As a first effort, forty-seven cartoon facial expressions of emotion were simply constructed by the author to generate a subset of items identified by a group of judges for the development of the F-PANAS. Because the items were not randomly drawn from a universe of items, the ability to generalize these results to similar items is unknown.

A further limitation of this study addresses the fidelity of the faces, which ties the findings of this research to the level of detail in the items. The cartoon facial expressions of emotion (found in Appendix A and B) only contain a minimal amount of detail. That is to say, only the eyes, eyebrows, and mouth (with an occasional use of a forehead crease) were used to represent an emotional expression. Other details, such as the nose that is wrinkled in the expression of disgust, were left out. When viewing a facial expression, these other details can influence the perception of emotion. For example, using real facial expressions - a participant might rate an attractive face of the opposite gender as having higher positive affect when smiling compared to a less attractive member of the same gender with the identical expression. Because the fidelity of the faces can have an impact on the results, to generalize beyond the fidelity of the facial expressions used in this study warrants caution.

The use of a computer to administer the instruments was also a limitation of the study. Early in the research it was found that a participant would sometimes depress the button used to indicate a response more than one time for a single item. This resulted in the participant answering the next item before it appeared on the screen, even though a response equal to the previous item was recorded. Instructions were altered (see Chapter 3) to make the participants aware of this possibility and to be cautious while indicating their responses.

The computer program also required a response from the participant for each item before advancing to the next item. In effect, the computer program did not allow a participant to skip (i.e., leave blank) any of the items. Unfortunately, blank items indicate ambiguity or lack of familiarity - information that would have been useful during the item analyses. The computer assessment also contained a large amount of items presented to the participant across several instruments, although it should be noted that the average time to complete all 220 questions was approximately 13 minutes. The effects of the number of items and instruments can be addressed with future studies while modifications in the computer program should be made to (a) protect the participant from answering a question before they have had a chance to read it and (b) include an option to "pass" on an item.

The limitations associated with computer assessment in this study (i.e., erroneous responses, inability to skip items, and the number of items), as a unique source of variance unrelated to the constructs, would have suppressed the reliability and validity coefficients. This suppression would have occurred evenly across the instruments because the order of the instruments was randomized for each participant. In addition, the order of the items was randomized for the F-PANAS and PANAS instruments. From this perspective, the reliability and validity coefficients would be considered conservative.

## Future Research

The F-PANAS was developed using a college population and may have the potential for use among other populations. Because the nature of the item is not bound by the limitations of language; the F-PANAS, with its promising psychometric properties, could be used with language impaired populations, cross-cultural populations, or with children. While the results cannot be generalized to these populations, the potential use for this instrument in these areas is encouraging. The NEO has been translated into other languages with some success, with the Big Five replicated after a modified rotation of the factor solution was initiated (McCrae & Costa, 1997). The universal meaning and the ability to cross language barriers are two advantages of using the F-PANAS items.

Laurent et al. (1999) developed a children's version of the PANAS (i.e., the PANAS-C) to differentiate between children that are depressed versus children that are anxious. An important point made by the authors, was that the development of an instrument using adults may warrant modification for use with children. Laurent et al.

(1999) used fourth and eighth graders as judges to select from the 60 items of the PANAS-X (Watson & Clark, 1994) which also contained the original 20 items of the PANAS (Watson, Clark, & Tellegen, 1988). Only 13 words from the original PANAS were retained, while 14 more were identified from the PANAS-X. It is noteworthy that less than half of the words that are typically used as descriptors of emotion for adults were retained for the use with children. Using this modified instrument (i.e., the PANAS-C), findings regarding the structure and relational aspects of PA and NA were consistent with previous findings that used adult populations. Future studies with child populations could investigate the utility of the alternative items (i.e., cartoon facial expressions of emotion) that were used in this study to develop the F-PANAS. It would be expected that a higher proportion of the F-PANAS items would be retained with a child population because cartoon facial expressions of emotion are independent of language.

To find the youngest age with which this test would have utility would require addressing the issue of development and discrimination of facial expressions. Possibly another question, developmentally, can address the changes that take place as children mature.

While there were several changes proposed in the limitations that included reducing a source of random error that was introduced through the use of a computer, further modifications of the computer program could provide some valuable information. An option included in the program that, when selected, would furnish a definition or description of the item on the computer screen. Tracking when a definition or description was accessed for an item would help identify ambiguous items while avoiding the disadvantage of having an item unanswered. In addition, modifying the computer program for administration across the internet could potentially gain access to other populations, while on the other hand, comparison of the results gleaned from a paper and pencil version of the F-PANAS could also be compared. Another area of research could have the participants create or modify a face to match an affective term, a description of an emotion, or a vignette, would be another method of generating potential items for future use.

Conclusions

There was an attempt here to develop a new instrument utilizing an alternative source of items for the first time to assess positive affect (PA) and negative affect (NA). Because affect fluctuates over time, two temporal aspects of PA and NA were measured (i.e., state and trait affect). Relatively high internal consistency and test-retest reliability coefficients coupled with strong evidence of construct, convergent, and discriminant validity - indicates that the F-PANAS has the necessary psychometric properties to begin exploration with other populations. In addition, theoretical implications led to the conclusion that PA and NA are relatively independent, but manifest a bipolar relationship with other positively and negatively defined constructs of affect and personality.

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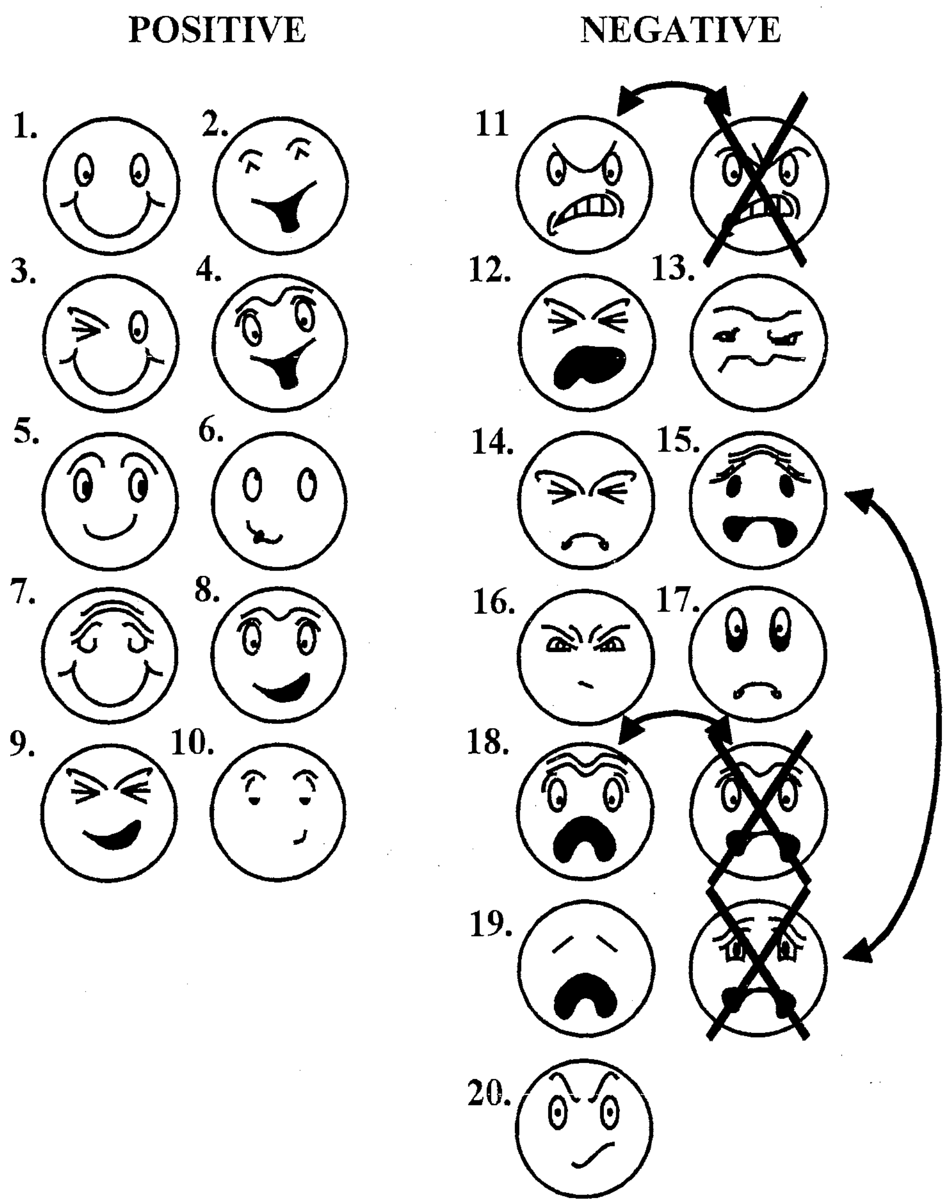
# APPENDICES

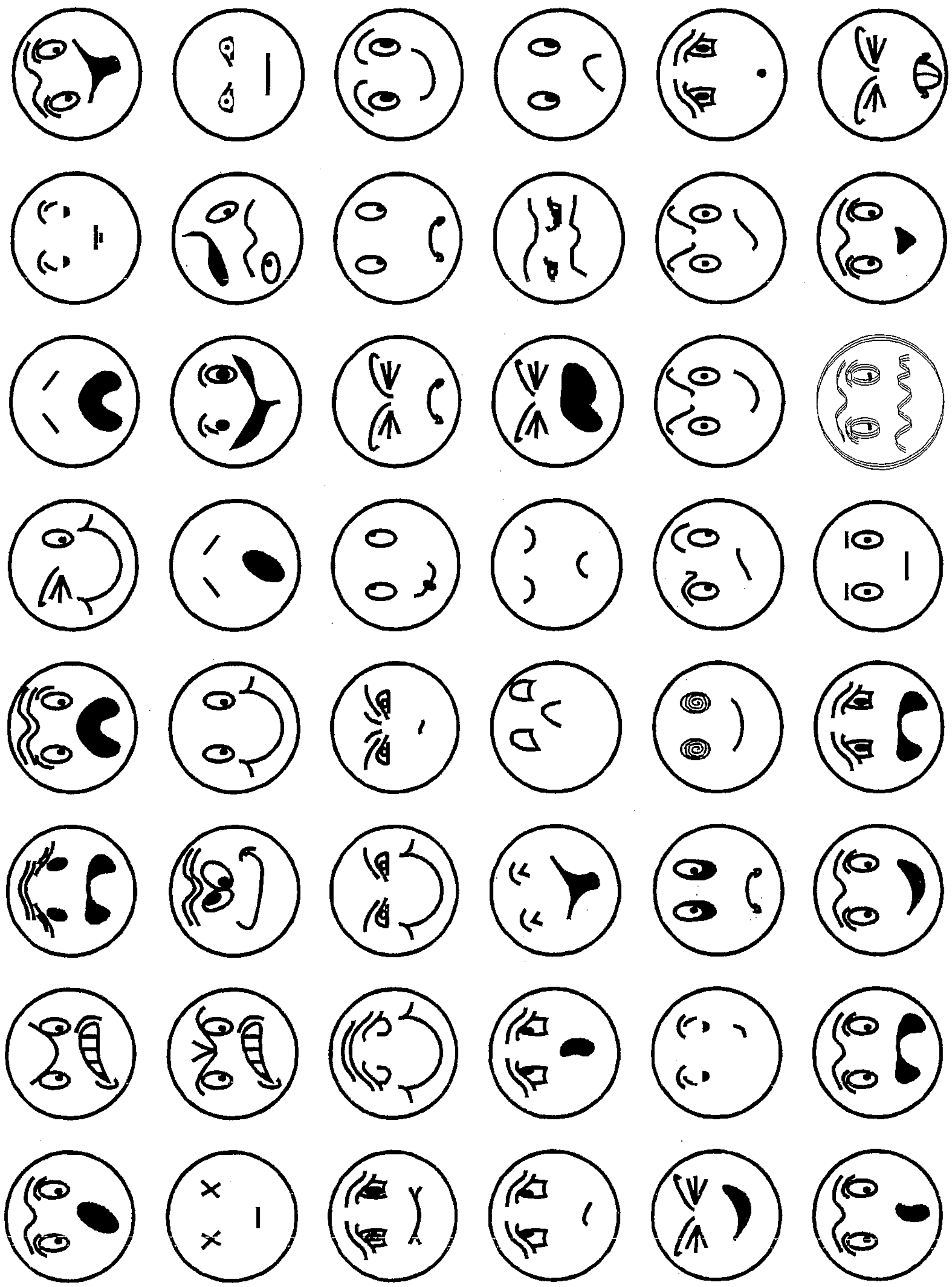
# Appendix A

## Facial-Positive Affect Negative Affect Scale (F-PANAS) Items



Appendix B

Cartoon Facial Expressions of Emotion



# Appendix C

## Descriptive Statistics for Other Instruments

PANAS Means, Standard Deviations, and t-tests for Gender

| State | *M* | *S.D.* | *t* |
|---|---|---|---|
| Positive Affect | | | |
| Males | 32.71 | 7.82 | .52 |
| Females | 32.25 | 8.05 | |
| Negative Affect | | | |
| Males | 14.92 | 5.85 | -.98 |
| Females | 15.60 | 6.43 | |
| **Trait** | | | |
| Positive Affect | | | |
| Males | 35.76 | 6.31 | -.31 |
| Females | 36.00 | 7.09 | |
| Negative Affect | | | |
| Males | 18.19 | 6.40 | -.99 |
| Females | 18.88 | 6.39 | |

Note. Scale development sample, $n = 375$.

STPI Means, Standard Deviations, t-tests, and Effect Sizes for Gender

| State | *M* | *S.D.* | *t* | **d** |
|---|---|---|---|---|
| Anxiety | | | | |
| Males | 17.94 | 5.26 | −2.00 | |
| Females | 19.22 | 6.09 | | |
| Curiosity | | | | |
| Males | 27.73 | 5.82 | 1.43 | |
| Females | 26.89 | 5.18 | | |
| Anger | | | | |
| Males | 13.00 | 5.31 | .44 | |
| Females | 12.77 | 4.65 | | |
| Depression | | | | |
| Males | 16.05 | 4.68 | −2.04* | .21 |
| Females | 17.18 | 5.67 | | |
| **Trait** | | | | |
| Anxiety | | | | |
| Males | 19.13 | 5.42 | −1.02 | |
| Females | 19.76 | 5.71 | | |
| Curiosity | | | | |
| Males | 28.88 | 4.90 | .27 | |
| Females | 28.34 | 4.59 | | |
| Anger | | | | |
| Males | 20.37 | 6.08 | .33 | |
| Females | 20.16 | 5.51 | | |
| Depression | | | | |
| Males | 17.47 | 4.88 | −1.13 | |
| Females | 18.15 | 5.70 | | |

Note. Scale development sample, $n = 375$. Absolute values for component loadings
*$p < .05$

NEO-FFI Means, Standard Deviations

| NEO-FFI | *M* | *S.D.* | *t* | **d** |
|---|---|---|---|---|
| Neuroticism | | | | |
| Males | 19.95 | 7.94 | −2.24* | .25 |
| Females | 21.92 | 8.03 | | |
| Extroversion | | | | |
| Males | 30.59 | 6.73 | −1.78 | |
| Females | 31.82 | 6.59 | | |
| Openness | | | | |
| Males | 29.41 | 7.00 | .03 | |
| Females | 29.38 | 6.61 | | |
| Agreeableness | | | | |
| Males | 29.31 | 6.61 | −2.22* | .24 |
| Females | 30.82 | 5.97 | | |
| Conscientiousness | | | | |
| Males | 29.80 | 6.69 | −2.68** | .29 |
| Females | 31.82 | 6.94 | | |

Note. Scale development sample, $n = 375$. Absolute values for component loadings
*$p < .05$
**$p < .01$

# Appendix D

## Oklahoma State University Internal Review Board Letter of Approval

**Oklahoma State University**
**Institutional Review Board**

Protocol Expires: 3/20/02

Date : Wednesday, March 21, 2001 IRB Application No ED0186

Proposal Title: A MEASURE OF POSITIVE AND NEGATIVE AFFECT USING CARTOON FACIAL EXPRESSIONS OF EMOTION

Principal
Investigator(s) :

| | |
|---|---|
| Mark Hamlin | Dale Fuqua |
| 444 Willard | 444 Willard |
| Stillwater, OK 74078 | Stillwater, OK 74078 |

Reviewed and
Processed as: Expedited

Approval Status Recommended by Reviewer(s) : Approved

Signature :

Carol Olson, Director of University Research Compliance

Wednesday, March 21, 2001
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

# Appendix E

## University of Central Oklahoma Internal Review Board Letter of Approval

UNIVERSITY OF CENTRAL OKLAHOMA

*College of Graduate Studies & Research*

2/5/2001

Mr. Mark Hamlin
Department of Psychology
Box 176 ON413
CAMPUS

Dear Mr. Hamlin:

The Institutional Review Board has reviewed your proposal "A Measure of Positive and Negative Affect using Cartoon Facial Expressions of Emotion" pursuant to the University's expedited review procedures. It has been determined that this research would not constitute a risk to the participants beyond those of normal, everyday life, except in the area of privacy. Privacy has been adequately protected by the confidentiality procedures of the project. Therefore, the use of human subjects has been approved.

The approval is for a period of twelve months from this date. Should any of the research protocol change you will need to resubmit an application to the IRB for further review before proceeding.

When the project terminates please submit a brief report describing the use of human subjects and the results. Beyond twelve months a progress report and a request for re-approval must be submitted.

A copy of your application and this letter will remain on file with the CGS&R IRB. Please contact Dr. Radke (974-3493) if you have any questions. Please accept my best wishes for the success of your project.

Sincerely,

W Radke

William J. Radke, Ph.D.
Assistant Dean
College of Graduate Studies and Research

Cc

*100 North University Drive, University Center, Room 404, Edmond, Oklahoma 73034-5209 · Phone: (405) 974-3341 or 3494*
*Fax: (405) 974-3852 · Email: gradcoll@ucok.edu*

# Appendix F

## Informed Consent Form

**CONSENT FORM**

I, ________________________, hereby authorize or direct Mark Hamlin, or associates or assistants of his or her choosing, to perform the following treatment or procedure.

The title of this project is ***Developing a nonverbal measure of affect using cartoon facial expression of emotion***. This project involves research conducted by the principal investigator, Mark Hamlin, as partial fulfillment of the requirements for the degree Doctor of Philosophy through Oklahoma State University and as a faculty member in the Department of Psychology at the University of Central Oklahoma.

The purpose of this research is to help create a self-report measure of mood using cartoon facial expressions. A computer program will present approximately 220 questions in the form of words, statements, and cartoon facial expressions. It is very important to read the instructions at the beginning of each part before the questions are presented so you know if the questions pertain to **how you feel righ now** OR **how you feel in general**. This procedure should take approximately thirty minutes.

If successful, this new self-report mood instrument could be used by (1) individuals across cultures because the language barrier is removed (2) young children that have not developed a sophisticated vocabulary or (3) any population with language impairments. This will not be possible without your cooperation.

A confidential number will be assigned and will be used to identify your data. If you would like to participate a second time in this research project, your confidential number will be used to match your previous responses. Your name will be stored with your confidential number separately from your responses, and after the research has been completed, the information matching confidential numbers with names will be destroyed. At no time will your name be stored with your responses. This is not a guarantee of confidentiality, but an explanation of how your confidentiality will be protected. If you would like to participate a second time in this research, you must wait at least two weeks before making a second appointment.

I understand that participation is voluntary and that I will not be penalized if I choose not to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty after notifying the project director. I may contact Mark Hamlin at telephone number (405)974-5452. I may also contact the University of Central Oklahoma Institutional Review Board, College of Graduate Studies & Research, Room 404, University Center, 100 N. University Drive, Edmond, OK 73034-5209, telephone number 405-974-3493 or Sharon Bacher, IRB Executive Secretary, Oklahoma State University, 203 Whitehurst, Stillwater, OK 74078. Phone: 405-744-5700.

I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: ____________________ Time: ____________________ (a.m./p.m.)

________________________________________________

Name (Please Print) Signature

I certify that I have personally explained all elements of this form to the subject or his/her representative before requesting the subject or his/her representative to sign it.

Signed: ________________________________________

Project director or authorized representative

# Appendix G

## Computer Assessment Screen Shots

Department of Psychology

FACIAL EXPRESSIONS
OF EMOTIONS

OSU

OKLAHOMA
STATE UNIVERSITY

**DISSERTATION COMMITTEE**

**Dale Fuqua, Ph.D.**
**Marcia Dickman, Ph.D.**
**Janice Williams-Miller, Ph.D.**
**John Chaney, Ph.D.**

**Spring 2001**

UCO

UNIVERSITY OF
CENTRAL OKLAHOMA

**DOCTORAL STUDENT**

**Design by: Mark Hamlin**
**Program by: Mark Hamlin**

**100 North University Drive**
**Edmond, OK 73034**

**email: mhamlin@ucok.edu**

click here to continue

Department of Psychology

FACIAL EXPRESSIONS
OF EMOTIONS

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David Watson, Ph.D.
Professor of Psychology
E11 Seashore Hall
University of Iowa
Iowa City, IA 52242-1407
From the Positive and Negative Affect Schedule - Expanded Form by David Watson and Lee Anna Clark. Copyright 1994 by David Watson and Lee Anna Clark.

Charles Spielberger, Ph.D., ABPP
Distinguished Research Professor
Director, Center for Research in Behavioral Medicine and Health Psychology
University of South Florida
Psychology Department
BEH 339 4202 E. Fowler Avenue
Tampa, FL 33620-8200
From the State Trait Personality Inventory by Charles Spielberger, Copyright 1995.

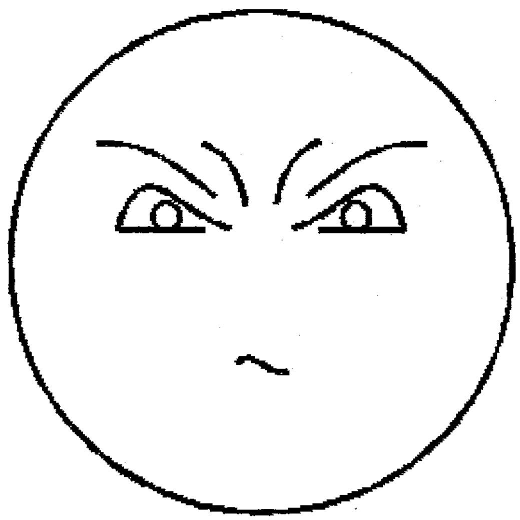
Psychological Assessment Resources, Inc.,
16204 North Florida Avenue
Lutz, Florida 33549
From the NEO Five Factor Inventory by Paul Costa and Robert McCrae.
Copyright 1978, 1985, 1989 by PAR Inc.

click here to continue

Expressions of Emotions

Part 3 of 7 Item 3 of 20

**You feel this way at the present, that is, how you feel right now.**



| not at all | a little | moderately | quite a bit | extremely |
| --- | --- | --- | --- | --- |

Expressions of Emotions

Part 3 of 7

Item 3 of 20

## You generally feel this way, that is, how you feel on the average.

## Hostile

not at all | a little | moderately | quite a bit | extremely

# VITA

Mark Elliot Hamlin

Candidate for the Degree of

Doctor of Philosophy

Thesis: A MEASURE OF POSITIVE AND NEGATIVE AFFECT USING CARTOON FACIAL EXPRESSIONS OF EMOTION

Major Field: Applied Behavioral Studies

Biographical:

Personal Data: Born in Pasadena, California, on August 23, 1968, the son of Stanley and Betty Hamlin, Jr. Marriage to Patricia Kae Hamlin of Quaker City, Ohio, on May 5, 1990, the daughter of Ray and Carol McVicker. Children include Elizabeth Madison, born on July 11, 1995; Ashley Starr, born on March 2, 1998; Shane Luke, born on June 30, 1999 in Oklahoma City, Oklahoma.

Education: Graduated from Juneau Douglas High School, Juneau, Alaska in May of 1986; received Bachelor of Science degree in Psychology from Oklahoma Christian University, Oklahoma City, Oklahoma in April of 1991; received Master of Arts degree in General Experimental Psychology from the University of Central Oklahoma, Edmond, Oklahoma in August of 1994. Completed the requirements for the Doctor of Philosophy at Oklahoma State University, Stillwater, Oklahoma in August, 2001.

Experience: Employed by the University of Central Oklahoma, Department of Psychology as a graduate assistant; employed as a research technician and statistician for Omni High-Tech Engineering for contract work at the Federal Aviation Administration Mike Monroney Aeronautical Center, Civil Aeromedical Institute, Oklahoma City, Oklahoma; employed by the University of Central Oklahoma, Department of Psychology as an Assistant Professor, 1994 to present.

Professional Memberships: American Psychological Association.