

Positive Emotions and the Autonomic Nervous System

Michelle N. Shiota, Ph.D. Department of Psychology, Arizona State University

Network for Emotional Well-Being October 25, 2022



Overview

- What is the role of positive emotions in well-being?
- What ANS-mediated physiological changes characterize positive emotion?
- How does physiological reactivity to positive emotion stimuli relate to well-being?
- What new research linking positive emotions, well-being, and health is needed next?



Overview

- What is the role of positive emotions in well-being?
- What ANS-mediated physiological changes characterize positive emotion?
- How does physiological reactivity to positive emotion stimuli relate to well-being?
- What new research linking positive emotions, well-being, and health is needed next?

What is Well-Being?



What is Well-Being?





















The Dispositional Positive Emotions Scale

- **Joy** (a.k.a. enthusiasm): "I am often completely overjoyed when something good happens."
- **Contentment**: "My life is very fulfilling."
- Love: "I develop strong feelings of closeness to people easily."
- **Compassion:** "Taking care of others gives me a warm feeling inside."
- **Pride**: "I am proud of myself and of my accomplishments."
- **Amusement**: "I find humor in almost everything."
- Awe: "I feel wonder almost every day."

Regression Weights, DPES Predictors of "Well-Being"

N = 223 adults in their 20s, 40s, 60s

Data from Shiota & Levenson, 2009

DPES Subscale	SWLS	PANAS-PA	PANAS-NA	SCL 90- Depression	SCL 90- Anxiety
Joy	.12	.41***	.40***	.13	.18
Contentment	.60***	27**	46***	38***	21+
Love	.05	.05	08	.05	.07
Compassion	12*	.03	.09	.19*	.02
Pride	.09	.45***	27**	34***	24*
Amusement	.04	05	.07	.05	.07
Awe	.03	.09	09	.01	.01

Regression Weights, DPES Predictors of "Well-Being"

N = 223 adults in their 20s, 40s, 60s

DPES Subscale	SWLS	PANAS-PA	PANAS-NA	SCL 90- Depression	SCL 90- Anxiety
Joy	.12	.41***	.40***	.13	.18
Contentment	.60***	27**	46***	38***	21+
Love	.05	.05	08	.05	.07
Compassion	12*	.03	.09	.19*	.02
Pride	.09	.45***	27**	34***	24*
Amusement	.04	05	.07	.05	.07
Awe	.03	.09	09	.01	.01



Overview

- What is the role of positive emotions in well-being?
- What ANS-mediated physiological changes characterize positive emotion?
- Does physiological reactivity to positive emotion stimuli predict well-being?
- What new research linking positive emotions, well-being, and health is needed next?

ANS Aspects of Positive Emotions

- $N = 37 (M_{age} = 18.8 \text{ years}; 76\% \text{ F})$
- WS Emotion Manipulation
- Trial Structure:
 - ✓ 60 second baseline
 - ✓ Six images, 90s total



Shiota, Neufeld, Yeung, Moser, & Perea, 2011

Neutral



Enthusiasm



Attachment Love



Nurturant Love



Awe



Amusement



ANS Aspects of Positive Emotions

- $N = 37 (M_{age} = 18.8 \text{ years}; 76\% \text{ F})$
- WS Emotion Manipulation
- Trial Structure:
 - ✓ 60 second baseline
 - ✓ Six images, 90s total

Measures:

- Heart rate (actually cardiac IBI)
- Respiration rate
- Cardiac pre-ejection period
- # skin conductance responses
- Mean arterial pressure
- Respiratory sinus arrhythmia



Shiota, Neufeld, Yeung, Moser, & Perea, 2011

ANS Aspects of Positive Emotions

- $N = 37 (M_{age} = 18.8 \text{ years}; 76\% \text{ F})$
- WS Emotion Manipulation
- Trial Structure:
 - ✓ 60 second baseline
 - ✓ Six images, 90s total

Measures:

- Heart rate (actually cardiac IBI)
- Respiration rate
- Cardiac pre-ejection period
- # skin conductance responses
- Mean arterial pressure
- Respiratory sinus arrhythmia



Shiota, Neufeld, Yeung, Moser, & Perea, 2011

Impedance Cardiography



Impedance Cardiography: electrical signal passed across chest wall indicates when aortic valve opens, blood shoots through aorta

Cardiac Pre-Ejection Period





- Pre-Ejection Period: time in ms from start of ventricle contraction
 (Q) to opening of aortic valve (B) = muscle contraction speed
- PEP is influenced <u>ONLY by sympathetic branch of ANS</u>, via activation of beta-adrenergic receptors on the heart

Skin Conductance Response



- The human body does a good job of conducting electricity. ③
- <u>Sympathetic activation</u> (via cholinergic receptors) puts slight pressure on sweat glands.
- Skin Conductance Response: Sweat (salt water) briefly increases electrical conductivity of the skin, speeding a signal passed between electrodes taped to two fingers.



	HR	RR	PEP	SCRs	MAP	RSA
Enthusiasm	↑	↑		↑	1	$\mathbf{+}$

Suggests broad \clubsuit sympathetic and \clubsuit parasympathetic



	HR	RR	PEP	SCRs	MAP	RSA
Enthusiasm	↑	1		1	↑	ł
Nurturant Love	1	↑				4
Attachment Love	1					$\mathbf{\Lambda}$

Suggests ♥ parasympathetic



	HR	RR	PEP	SCRs	MAP	RSA
Enthusiasm	↑	↑		1	↑	ł
Nurturant Love	1	↑				4
Attachment Love	1					\mathbf{A}
Amusement		1				

Little effect; other studies show **↑** sympathetic



	HR	RR	PEP	SCRs	MAP	RSA
Enthusiasm	1	↑		1	↑	ł
Nurturant Love	1	↑				\mathbf{A}
Attachment Love	1					$\mathbf{\Lambda}$
Amusement		↑				
Awe		↑	1			$\mathbf{\Lambda}$

Suggests **V** both sympathetic and parasympathetic on heart



	HR	RR	PEP	SCRs	MAP	RSA
Enthusiasm	★	1		1	1	ł
Nurturant Love	1	1				\mathbf{A}
Attachment Love	1					\mathbf{A}
Amusement		1				
Awe		1	1			\mathbf{A}

Different positive emotions, different physiological profiles



In the broader literature...

- Others are characterized by physiological <u>soothing</u>, reflecting parasympathetic (typically vagal) and/or hormonal influence
- Many positive emotion states (including contentment, pride) have received little or no study re: ANS aspects.
- Baseline ANS correlations with <u>trait</u> PE may differ from, even oppose, reactivity seen in tasks evoking PE states.

e.g., Behnke et al., 2022; Kreibig, 2010; Oveis et al., 2009



Overview

- What is the role of positive emotions in well-being?
- What ANS-mediated physiological changes characterize positive emotion?
- How does physiological reactivity to positive emotion stimuli relate to well-being?
- What new research linking positive emotions, well-being, and health is needed next?

Adult Attachment







Proximity Seeking Secure Base Safe Haven

Hazan & Shaver, 1987

Adult Attachment Style

Mental model of what can be expected from close others, reflected in one's typical affect and behavior in intimate relationships



Secure: Positive expectations about close others' accessibility and responsiveness



Anxiety: Intense need for intimacy, with fear of abandonment



Avoidance: Discomfort with depending on others, intimacy, commitment

Today's Focus



Secure Base



Do attachment anxiety and/or avoidance predict degree of physiological orienting toward positive stimuli, i.e., potential rewards?

- Cardiac Deceleration: Slowing of heart rate; primarily reflects <u>attentional engagement</u>
- Skin Conductance Response: Brief burst of sweat gland activity; primarily reflects preparation for action

Cardiac Deceleration

- No multivariate main effect of either Anxiety or Avoidance (p's > .50)
 - Suggests attentional orienting to rewards largely unaffected by lack of a secure base
 - Exception: Enthusiasm "lottery" slides; did they not believe we'd give the payment?

	ANX	AVOID
Enthusiasm	34*	30+
Attachment Love	23	28
Nurturant Love	.13	17
Amusement	09	01
Awe	21	13

Skin Conductance

- Multivariate main effect of Avoidance, F (5,23) = 3.01, p=.03
 - Reduced approach orientation toward rewards, due to lack of secure base?
 - Includes material & aesthetic rewards as well as social rewards
- No multivariate main effect of Anxiety

	ANX	AVOID
Enthusiasm	23	35*
Attachment Love	03	06
Nurturant Love	01	30+
Amusement	17	28
Awe	06	38*



Overview

- What is the role of positive emotions in well-being?
- What ANS-mediated physiological changes characterize positive emotion?
- How does physiological reactivity to positive emotion stimuli relate to well-being?
- What new research linking positive emotions, wellbeing, and health is needed next?







Summary

- High dispositional positive affect/activation/emotion is commonly considered a defining feature of well-being.
- Multiple positive emotion states exist; these vary in ANS profile, and how they relate to other aspects of WB.
 - Several involve <u>heightened</u> SNS/<u>reduced</u> PNS influence, e.g. on heart
 - Cannot assume trait- vs. state-level ANS-WB relations will be same
- More rigorous research is needed to characterize ANS aspects of understudied positive emotions; implications for well-being.
- Physiological markers of well-being should be those that facilitate context-appropriate motivational responses to the current situation (e.g., distinct kinds of adaptive opportunities).

Thank you!

- The Network for Emotional Well-Being (NEW-B)
- National Institute on Aging
- Bob Levenson, Sammi Neufeld, Ellen Yeung, Stephanie Moser, Elaine Perea, Claire Yee, and the SPLAT Lab



