Psychometric properties of startle and corrugator response in NPU, Affective Picture Viewing, and Resting State tasks

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Supplemental Materials

Method

Self-report Battery

At the first study visit only, participants completed a battery of self-report questionnaires on an iPad (Apple Inc.) using Qualtrics (Provo, UT) software to assess demographics information, trait affect, and broadband personality traits. Surveys included the Depression Anxiety Stress Scale 21 (Lovibond & Lovibond, 1995), Anxiety Sensitivity Index – 3 (Taylor et al., 2007), Intolerance of Uncertainty Inventory – Part A (Carleton, Norton, & Asmundson, 2007), Behavioral Activation and Behavioral Inhibition Scales (Carver & White, 1994), Brief Multidimensional Personality Questionnaire (Patrick, Curtin, & Tellegen, 2002), Externalizing Spectrum Inventory – 100 (Krueger, Markon, Patrick, Benning, & Kramer, 2007). These data were collected for aims not relevant to the current psychometric evaluation of the tasks reported in this manuscript and are not analyzed or reported here.

Results

Table S1. Post-NPU Task Subjective self-report measures Mean (SD). After the NPU task, participants retrospectively reported their anxiety/fear during the cue in each condition (Bradford, Shapiro, & Curtin, 2013; Schmitz & Grillon, 2012). Ratings were made on a 5-point likert scale from 1 (not anxious/fearful) to 5 (very anxious/fearful).

	Study Visit 1	**Study Visit 2**
No Shock	1.26 (0.52)	1.18 (0.42)
Predictable Shock	3.55 (0.95)	3.45 (0.89)
Unpredictable Shock	4.01 (0.98)	3.82 (0.99)

Table S2. IAPS Picture Normative Mean (SD) Male and Female Valence and Arousal Ratings for Photograph Sets A and B from Lang, Bradley, and Cuthbert (2008). Ratings were made on a 9-point scale using the Self-Assessment Manikin (SAM; Lang, Bradley, & Cuthbert, 2008). Ratings were scored so that 9 represents high arousal or high positive valence and 1 represents low arousal or high negative valence.

	Set A		Set B	
	Male	**Female**	**Male**	**Female**
Valence				
Unpleasant	2.23 (1.41)	1.63 (1.03)	2.21 (1.46)	1.65 (1.05)
Pleasant	7.43 (1.55)	7.29 (1.58)	7.38 (1.52)	7.24 (1.60)
Neutral	4.89 (1.25)	4.95 (1.23)	4.83 (1.11)	5.10 (1.23)
Arousal				
Unpleasant	6.07 (2.21)	6.83 (2.11)	6.03 (2.26)	6.77 (2.10)
Pleasant	6.18 (2.12)	5.89 (2.24)	6.08 (2.14)	5.78 (2.32)
Neutral	2.70 (1.79)	2.91 (1.86)	2.63 (1.86)	2.94 (1.89)

Table S3. IAPS Picture Study Sample Mean (SD) Male and Female Valence and Arousal Ratings for Photograph Sets A and B. After the Affective Picture Viewing Task, participants viewed the same 36 pictures again on an iPad and rated the subjective valence and arousal of each picture. Ratings were made on a 9-point scale using the Self-Assessment Manikin (SAM; Lang et al., 2008). Ratings were scored so that 9 represents high arousal or high positive valence and 1 represents low arousal or high negative valence.

	Set A		**Set B**	
	Male	**Female**	**Male**	**Female**
Valence				
Unpleasant	2.51 (0.80)	2.18 (0.75)	2.56 (0.88)	2.1 (0.72)
Pleasant	6.6 (0.73)	6.57 (0.90)	6.69 (0.81)	6.55 (0.82)
Neutral	4.93 (0.42)	5.17 (0.60)	5.07 (0.63)	5.24 (0.59)
Arousal				
Unpleasant	5.08 (1.6)	5.18 (1.72)	5.01 (1.63)	5.19 (1.64)
Pleasant	4.66 (1.33)	4.17 (1.49)	4.68 (1.44)	4.11 (1.53)
Neutral	2.36 (1.15)	1.87 (0.84)	2.4 (1.06)	2.01 (0.90)
Viewing Time (s)				
Unpleasant	3.43s (1.76)	2.78s (1.43)	3.01s (1.67)	2.52s (1.01)
Pleasant	3.73s (1.74)	2.83s (1.40)	3.67s (1.62)	3.28s (3.91)
Neutral	2.93s (1.16)	2.60s (0.91)	2.87s (0.89)	2.58s (0.96)

Table S4: Effect Size and Stability for Startle Response across Study Visits by Task Condition and Quantification Method

	QUANTIFICATION: Raw Scores			QUANTIFICATION: Standardized Scores		
TASK: NPU	**Visit 1**	**Visit 2**	**Mean**	**Visit 1**	**Visit 2**	**Mean**
No Shock [a]	51.5 [46.9, 56.0]	45.8 [41.3, 50.4]	48.7 [44.4, 52.9]	45.8 [45.3, 46.3]	45.9 [45.4, 46.5]	45.9 [45.4, 46.3]
Predictable Shock [b]	87.8 [81.1, 94.4]	83.5 [77.1, 90.0]	85.7 [79.7, 91.6]	55.3 [54.5, 56.0]	56.1 [55.2, 57.0]	55.7 [55.0, 56.4]
Unpredictable Shock [ab]	79.7 [73.7, 85.1]	70.3 [64.6, 76.0]	74.9 [69.7, 80.0]	53.3 [52.7, 54.0]	52.4 [51.8, 53.0]	52.9 [52.4, 53.4]

	QUANTIFICATION: Raw Scores			QUANTIFICATION: Standardized Scores		
TASK: Affective Picture Viewing	**Visit 1**	**Visit 2**	**Mean**	**Visit 1**	**Visit 2**	**Mean**
Neutral Picture [a]	41.6 [37.1, 46.0]	37.0 [32.5, 41.5]	39.3 [35.0, 43.5]	49.1 [48.6, 49.6]	48.7 [48.1, 49.2]	48.9 [48.5, 49.3]
Pleasant Picture [b]	37.4 [33.7, 41.0]	35.7 [31.5, 40.0]	36.5 [32.9, 40.2]	47.6 [47.1, 48.1]	48.4 [47.8, 49.0]	48.0 [47.6, 48.4]
Unpleasant Picture [b]	47.2 [42.7, 51.6]	45.5 [40.7, 50.3]	46.3 [42.0, 50.7]	52.2 [51.6, 52.9]	53.5 [52.9, 54.1]	52.9 [52.4, 53.4]

NOTES: Table cells contain effect sizes for startle response in magnitude (i.e. point estimate of effect from general linear model analyses in microvolts or T-score units depending on quantification method) in each task condition for study visit 1, study visit 2, and the mean across visits for the two tasks and two quantification methods. This table displays startle response effect sizes by each task conditions as a supplement to Table 1 that displays startle potentiation (vs. no shock) and startle modulation (vs. neutral pictures). We removed model outliers from data analyses of task condition following similar procedures to those described in the Results section. We also report 95% confidence intervals in brackets.

a – Indicates significant ($p < .05$) Study Visit effect for raw score quantification
b – Indicates significant ($p < .05$) Study Visit effect for standardized score quantification

Table S5: Effect Size and Stability for Corrugator Response across Study Visits by Task Condition and Quantification Method

	QUANTIFICATION: Raw Scores in Time Domain			QUANTIFICATION: Power in Frequency Domain		
TASK: NPU	**Visit 1**	**Visit 2**	**Mean**	**Visit 1**	**Visit 2**	**Mean**
No Shock	.36 [.31, .41]	.40 [.33, .46]	.38 [.33, .42]	.012 [.002, .021]	.014 [.007, .021]	.013 [.007, .019]
Predictable Shock	.59 [.46, .72]	.62 [.49, .75]	.61 [.49, .72]	.020 [.006, .035]	.035 [.017, .053]	.028 [.014, .041]
Unpredictable Shock	.63 [.51, .75]	.63 [.51, .74]	.63 [.52, .74]	.043 [.023, .064]	.042 [.023, .061]	.043 [.024, .061]

	QUANTIFICATION: Raw Scores in Time Domain			QUANTIFICATION: Power in Frequency Domain		
TASK: Affective Picture Viewing	**Visit 1**	**Visit 2**	**Mean**	**Visit 1**	**Visit 2**	**Mean**
Neutral Picture	.38 [.27, .50]	.32 [.22, .43]	.35 [.26, .45]	.026 [.004, .048]	.005 [-.019, .028]	.015 [-.004, .035]
Pleasant Picture	.35 [.22, .48]	.36 [.22, .49]	.35 [.24, .47]	.028 [.006, .051]	.020 [-.014, .054]	.024 [.000, .049]
Unpleasant Picture	1.10 [.90, 1.31]	1.19 [.94, 1.44]	1.15 [.94, 1.35]	.125 [.080, .170]	.141 [.091, .191]	.133 [.089, .177]

NOTES: Table cells contain effect sizes for corrugator response in magnitude (i.e. point estimate of effect from general linear model analyses in microvolts or Power Spectral Density units depending on quantification method) in each task condition for study visit 1, study visit 2, and the mean across visits for the two tasks and two quantification methods. This table displays corrugator response effect sizes by each task conditions as a supplement to Table 2 that displays corrugator potentiation (vs. no shock) and corrugator modulation (vs. neutral pictures). We removed model outliers from data analyses of task condition following similar procedures to those described in the Results section. We also report 95% confidence intervals in brackets.

a – Indicates significant ($p < .05$) Study Visit effect for raw scores in the time domain quantification method
b – Indicates significant ($p < .05$) Study Visit effect for power scores in the frequency domain quantification method

Table S6: Internal Consistency and Temporal Stability of Startle Response by Task Condition and Quantification Method

TASK: NPU	QUANTIFICATION: Raw Scores	QUANTIFICATION: Standardized Scores
Internal Consistency		
No Shock [c]	.98 [.97, .99]*	.47 [.23, .63]*
Predictable Shock [c]	.96 [.94, .97]*	.37 [.09, .57]*
Unpredictable Shock [c]	.95 [.93, .97]*	.28 [-.04, .50]
Temporal Stability		
No Shock [c]	.93 [.90, .95]*	.55 [.41, .67]*
Predictable Shock [c]	.89 [.85, .93]*	.52 [.37, .64]*
Unpredictable Shock [c]	.90 [.86, .93]*	.33 [.16, .48]*

TASK: Affective Picture Viewing	QUANTIFICATION: Raw Scores	QUANTIFICATION: Standardized Scores
Internal Consistency		
Neutral Picture [c]	.97 [.96, .98]*	-.17 [-.42, .16]
Pleasant Picture [c]	.96 [.94, .97]*	-.17 [-.42, .16]
Unpleasant Picture [c]	.97 [.95, .98]*	-.05 [-.34, .27]
Temporal Stability		
Neutral Picture [c]	.92 [.89, .95]*	.28 [.11, .44]*
Pleasant Picture [c]	.91 [.87, .94]*	.21 [.03, .37]*
Unpleasant Picture [c]	.93 [.90, .95]*	.37 [.20, .51]*

NOTES: Table cells contain estimates of internal consistency (i.e., Spearman brown corrected Pearson correlations between odd and event trials) and temporal stability (Pearson correlations between study visit 1 and 2) in each task condition for startle response in each condition for the three tasks and two quantification methods. This table displays startle response internal consistency and temporal stability by each task conditions as a supplement to Table 3 that displays startle potentiation (vs. no shock) and startle modulation (vs. neutral pictures). We removed model outliers from data analyses of task condition following similar procedures to those described in the Results section. We also report 95% confidence intervals for these correlations in brackets.

* – Indicates significant (non-zero) correlation ($p < .05$)

c – Indicates significant difference ($p < .05$) in psychometric property (i.e., internal consistency or temporal stability) between raw and standardized score quantification methods.

Table S7: Internal Consistency and Temporal Stability of Corrugator Response by Task Condition and Quantification Method

TASK: NPU	QUANTIFICATION: Raw Scores in Time Domain	QUANTIFICATION: Power in Frequency Domain
Internal Consistency		
No Shock [c]	-.08 [-.38, .26]	-.34 [-.55, -.02]
Predictable Shock [c]	.68 [.54, .79]*	.33 [.01, .55]*
Unpredictable Shock [c]	.66 [.50, .77]*	.22 [-.13, .47]
Temporal Stability		
No Shock	.23 [.04, .40]*	.16 [-.03, .34]
Predictable Shock	.59 [.45, .70]*	.45 [.29, .59]*
Unpredictable Shock	.62 [.49, .72]*	.69 [.58, .78]*

TASK: Affective Picture Viewing	QUANTIFICATION: Raw Scores in Time Domain	QUANTIFICATION: Power in Frequency Domain
Internal Consistency		
Neutral Picture	.64 [.49, .75]*	.63 [.47, .75]*
Pleasant Picture [c]	.63 [.47, .75]*	.14 [-.20, .40]
Unpleasant Picture	.71 [.58, .80]*	.77 [.67, .84]*
Temporal Stability		
Neutral Picture	.48 [.33, .61]*	.48 [.33, .61]*
Pleasant Picture	.45 [.29, .58]*	.49 [.34, .62]*
Unpleasant Picture	.62 [.50, .72]*	.69 [.58, .77]*

NOTES: Table cells contain estimates of internal consistency (i.e., Spearman brown corrected Pearson correlations between odd and event trials) and temporal stability (Pearson correlations between study visit 1 and 2) in each task condition for corrugator response in each condition for the two tasks and two methods. This table displays corrugator response internal consistency and temporal stability by each task conditions as a supplement to Table 4 that displays corrugator potentiation (vs. no shock) and corrugator modulation (vs. neutral pictures). We removed model outliers from data analyses of task condition following similar procedures to those described in the Results section. We also report 95% confidence intervals for these correlations in brackets.

* - Indicates significant (non-zero) correlation ($p < .05$)
c – Indicates significant difference ($p < .05$) in psychometric property (i.e., internal consistency or temporal stability) between quantification methods of raw scores in time domain and power spectral density scores in the frequency domain.

Table S8: Number of Valid Trials Analyzed for Startle Response across Study Visits by Task Condition and Quantification Method

		QUANTIFICATION: Raw Scores		QUANTIFICATION: Standardized Scores	
TASK: NPU	**Total Trials**	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 2**
No Shock	12	11.9 (0.4)	11.7 (0.7)	11.9 (0.4)	11.7 (0.7)
Predictable Shock	8	7.9 (0.3)	7.9 (0.3)	7.9 (0.3)	7.9 (0.6)
Unpredictable Shock	8	7.9 (0.3)	7.9 (0.4)	7.9 (0.3)	7.9 (0.4)

		QUANTIFICATION: Raw Scores		QUANTIFICATION: Standardized Scores	
TASK: Affective Picture Viewing	**Total Trials**	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 2**
Neutral Picture	8	7.8 (0.4)	7.9 (0.4)	7.8 (0.4)	7.9 (0.4)
Pleasant Picture	8	7.9 (0.3)	7.8 (0.5)	7.9 (0.3)	7.8 (0.4)
Unpleasant Picture	8	7.8 (0.4)	7.8 (0.4)	7.9 (0.4)	7.8 (0.4)

		QUANTIFICATION: Raw Scores	
TASK: Resting State	**Total Trials**	**Visit 1**	**Visit 2**
General Startle Reactivity	6	5.9 (0.3)	5.9 (0.4)

NOTES: Table cells contain number of valid trials for each participant's startle response after rejecting trials for artifact. We exclude participants for methodological reasons noted in the Methods section (e.g., startle non-responders) and model outliers following similar procedure to those described in the Results section. We report mean (SD) number of valid trials across participants per task condition as well as the total number of trials that could have possibly contributed to each participants' average.

Table S9: Number of Valid Trials Analyzed for Corrugator Response across Study Visits by Task Condition and Quantification Method

		QUANTIFICATION: Raw Scores in Time Domain		QUANTIFICATION: Power in Frequency Domain	
TASK: NPU	**Total Trials**	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 2**
No Shock	16-18 ǂ	17.0 (1.0)	17.0 (1.0)	16.9 (1.1)	16.9 (1.0)
Predictable Shock	12	12.0 (0.2)	12.0 (0.3)	11.9 (0.5)	12 (0.3)
Unpredictable Shock	10	10.0 (0.1)	10.0 (0.0)	10.0 (0.2)	9.9 (0.5)

		QUANTIFICATION: Raw Scores in Time Domain		QUANTIFICATION: Power in Frequency Domain	
TASK: Affective Picture Viewing	**Total Trials**	**Visit 1**	**Visit 2**	**Visit 1**	**Visit 2**
Neutral Picture	12	12.0 (0.3)	11.9 (0.4)	12 (0.2)	11.9 (0.4)
Pleasant Picture	12	12.0 (0.2)	11.9 (0.3)	11.9 (0.3)	11.9 (0.4)
Unpleasant Picture	12	12.8 (0.8)	11.8 (0.8)	11.6 (1.0)	11.7 (1.0)

NOTES: Table cells contain number of valid trials for each participant's corrugator response after rejecting trials for artifact or other methodological reasons (e.g., unpredictable shock trials with shock occurring <4s post-cue onset) noted in the 'Corrugator Response Measurement and Data Reduction". We exclude participants for methodological reasons noted in the Methods section (e.g., >25% of trials contain artifact, excessive 60Hz noise) and model outliers following similar procedure to those described in the Results section. We report mean (SD) number of valid trials across participants per task condition as well as the total number of trials that could have possibly contributed to each participants' average.

ǂ Two trials in the No Shock condition were excluded because a startle probe occurred <2 s prior to cue-onset in two of the four trial structures used in this study for counterbalancing. Therefore half the participants had 18 total trials and half the participants had 16 total trials available for corrugator response analysis.

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