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Validating Emotional Attention Regulation as a Component of Emotional Intelligence: A Stroop Approach to Individual Differences in Tuning in to and Out of Nonverbal Cues

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Emotional intelligence (EI) has captivated researchers and the public alike, but it has been challenging to establish its components as objective abilities. Self-report scales lack divergent validity from personality traits, and few ability tests have objectively correct answers. We adapt the Stroop task to introduce a new facet of EI called emotional attention regulation (EAR), which involves focusing emotion-related attention for the sake of information processing rather than for the sake of regulating one's own internal state. EAR includes 2 distinct components. First, tuning in to nonverbal cues involves identifying nonverbal cues while ignoring alternate content, that is, emotion recognition under conditions of distraction by competing stimuli. Second, tuning out of nonverbal cues involves ignoring nonverbal cues while identifying alternate content, that is, the ability to interrupt emotion recognition when needed to focus attention elsewhere. An auditory test of valence included positive and negative words spoken in positive and negative vocal tones. A visual test of approach–avoidance included green- and red-colored facial expressions depicting happiness and anger. The error rates for incongruent trials met the key criteria for establishing the validity of an EI test, in that the measure demonstrated test–retest reliability, convergent validity with other EI measures, divergent validity from factors such as general processing speed and mostly personality, and predictive validity in this case for well-being. By demonstrating that facets of EI can be validly theorized and empirically assessed, results also speak to the validity of EI more generally.

Keywords: emotional intelligence, Stroop, emotion recognition, emotion regulation, individual differences

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Emotional intelligence (EI) has captured the attention of researchers, practitioners, and the public alike. However, available evidence that EI is a valid concept lags behind popular claims and excitement. Popularized trait and "mixed-model" approaches to EI (e.g., Goleman, Boyatzis, & McKee, 2002) use self-report questionnaires and suffer from low divergent validity from existing personality traits and low predictive validity above and beyond them (Joseph & Newman, 2010). Ability approaches (e.g., Mayer, Caruso, & Salovey, 1999) rely on tests to capture EI performance but typically lack objective standards for correct responses. For the sake of scoring these tests, the answer key consists of the average response from previous participants or from the subjective judgments of experts. The meaning of this consensus can be ambiguous to interpret, in that modal responses can represent common perceptions that are not necessarily correct. In particular, this practice makes it impossible to identify emotional "geniuses" who are capable of understanding processes that confound the majority of test takers. There are notable exceptions of EI measures that use truly objective criteria. The current article introduces a novel approach to expand this work.

Among the existing EI tests with objective criteria, many fall within a decades-old tradition of testing emotion recognition, in which stimuli consist of nonverbal cues of emotion that were posed with specific intentions (e.g., Nowicki & Duke, 1994; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). Participants typically enter a multiple-choice judgment from a set of emotional

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A copy of the Tuning in to and Out of Nonverbal Cues of Emotion measure that is presented in this article is available free of charge for noncommercial use by request from Hillary Anger Elfenbein. We thank Gavin Kilduff for comments on an early version of the research protocol.

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states, and the criterion for accurate responding is based on whether there is a match between these judgments and the posers' original intentions. In tests of expressive accuracy, participants provide samples of nonverbal cues with the goal of conveying specific emotional states, and their responses are based on the proportion of outside observers who could detect the intended states (Elfenbein & Eisenkraft, 2010; Gross & Levenson, 1993). Expressive flexibility has been measured by exposing individuals to emotionally evocative stimuli and recording their nonverbal behavior during within-subject conditions in which they believe they are unwatched, attempt to convey their internal states to an audience, and attempt to hide their internal states from an audience (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004). Flexibility is determined by the difference between outside observers' ability to detect the emotionally evocative stimuli in the conditions to convey and hide nonverbal cues, and their ability to do so when they believed that they were not being watched. Finally, emotion understanding has been tested with objective standards based on psychological theory. McCann and Roberts (2008) created a situational judgment task in which the accurate response is determined by the longstanding appraisal theory of emotion (Ellsworth & Scherer, 2003).

In this study, we adapt the classic Stroop (1935) task. Stroop tasks are designed to measure a perceiver's ability to attend to one feature of a stimulus while ignoring task-irrelevant features of the stimulus (Perlstein, Carter, Barch, & Baird, 1998). In the most commonly used version of the task, participants attempt to identify the color of a word that is itself the name of a color. Their performance is measured in terms of the difference in reaction time (RT) to name the color of congruent stimuli (e.g., the word *orange* written in orange font) versus incongruent stimuli (e.g., the word *green* written in orange font). An undesirable interference effect is seen in the form of a larger gap in the amount of time or accuracy levels in identifying incongruent versus congruent stimuli. Individuals with greater similarity in their reaction times or accuracy for congruent and incongruent stimuli are higher performers, because they can more successfully limit distraction from irrelevant information that interferes with their goals.

In our adaptation of the Stroop task, emotion-related content is presented using emotion cues. We test two modalities, both auditory and visual. In the auditory modality, positive and negative words are spoken in positive and negative vocal tones. For example, the word *funeral* is spoken with a sad voice in one trial and with a cheerful voice in another trial. Participants enter judgments of whether each stimulus is positive or negative. In one condition their judgment is based on the semantic meaning of the spoken word while ignoring the vocal tone, and in another condition it is based on the vocal tone while ignoring the spoken word's semantic meaning. This subtest represents judgments of positive–negative emotional valence, which is a fundamental feature of emotion that is also known as primary appraisal (Lazarus, 1991). In the visual modality, green and red colors appear on happy and angry facial expressions. For example, the same photo of an angry person appears in green in one trial and in red in another trial. Participants enter judgments of whether each stimulus should make a person want to stop or go. In one condition this judgment is based on the color while ignoring the facial expression, and in another condition it is based on the facial expression while ignoring the color. This subtest represents judgments of approach–avoidance, which is also another fundamental feature of emotion incorporated into appraisal theories. On the basis of their action tendencies—that is, the typical behavioral pattern associated with each emotional state (Frijda, 2007; Lazarus, 1991)—happiness is a clear indicator of a social partner who can be approached, and anger is a clear indication of a social partner who should be avoided.

It is worth noting that most research use of the Stroop task involves participants naming the color of the font while attempting to ignore the semantic meaning of the word. However, in Stroop's (1935) original article, he included multiple conditions, including one in which participants attempted to name the color of the font while ignoring the word's meaning and another in which they attempted to identify the word's meaning while ignoring the color in which it was written. Our emotions Stroop task attempts to mirror the original task by including the multiple conditions that he did. The first condition is called *tuning in to nonverbal cues* (TINC), and it involves identifying nonverbal cues of emotion while ignoring alternate content. In the auditory modality, this means judging the vocal tone while ignoring the semantic content of the word. In the visual modality, this means judging whether the emotional expression would make a person want to stop or go, while ignoring the color of the photo. The second condition is called *tuning out of nonverbal cues* (TONC), and it involves ignoring nonverbal cues of emotion while identifying the alternate content. In the auditory modality, this means judging the semantic content of the word while ignoring the vocal tone. In the visual modality, this means judging whether the color of the photo would make a person want to stop or go, while ignoring the emotional expression. The psychological meaning of these two conditions is discussed next.

Although the Stroop paradigm has been previously adapted into the realm of emotion, these studies differ in substantial ways from our own. Notably, most of these investigations have mixed judgments of emotion and nonemotion content. Studies have often examined RT differences while identifying colors in emotion words versus nonemotion words. As such, these versions are not truly comparable to the original Stroop task, because they mix judgments of color and emotion content. The original Stroop (1935) task included color words written in colored font, and so both congruent and incongruent information in this task involved the concept of color. By contrast, stimuli in most existing emotion Stroop adaptations are not truly compatible versus incompatible with each other. For example, Coffey, Berenbaum, and Kerns (2003) presented happy, neutral, sad, and fearful faces, each in blue, yellow, red, and green colors. Isaac et al. (2012) presented depressed, angry, and neutral facial expressions, also each in blue, yellow, red, and green colors. These colors do not map onto the expressions in a compatible versus incompatible manner. Other existing emotion Stroop tasks do include interference between factors that are both emotional in nature. Some tasks involve overlaying emotional expressions with emotion words, for example to show that these mixed stimuli create interference (Cothran, Larsen, Zelenski, & Prizmic, 2012) or to document the brain regions activated during administration of the task (Ovaysikia, Tahir, Chan, & DeSouza, 2011). Although these modalities—that is, expressions and words—both involve emotion, they appear alongside each other without being literally the modality through which the other is expressed. That is, words and expressions can be superimposed onto each other, but each could appear in the absence of the other. By contrast, as in the case of our study, every facial expression must be conveyed in a color of some kind. In this sense, our study focuses on the interference between forms of information that are integral to each other. In another study using emotion cues, Clayson and Larson (2013) examined interference on the basis of whether eyes and mouths were from the same versus different emotion.

There were two reasons motivating the development of a new task. First, we wanted to include two emotional modalities, each tested individually, namely facial expressions and vocal tones. In past research on nonverbal behavior, accuracy in judging facial expressions and vocal tones have not typically had high enough correlations to suggest redundancy (Nowicki & Duke, 1994; Rosenthal et al., 1979). Our second reason to create a new task was to test the two potentially distinct forms of interference involved in the original Stroop (1935) task, namely both tuning in to and out of nonverbal cues.

We argue that tuning in to and out of nonverbal cues are abilities that fall within the larger umbrella of what is considered emotional intelligence, while introducing the novel concept of emotion attention regulation (EAR). EI has been conceptualized as an umbrella model in the sense that it incorporates multiple facets, each of which is related to effectiveness in the realm of emotion yet covers a theoretically distinct process (Davies, Stankov, & Roberts, 1998; Mayer, Roberts, & Barsade, 2008). In the present study, we highlight two facets, without attempting to span the entire conceptual space occupied by EI. In doing so, we focus on EAR as the attempt to regulate one's attention toward emotion-related stimuli, not necessarily for the sake of influencing one's own internal state but for the sake of facilitating information processing. The conceptual meaning of tuning in to nonverbal cues (TINC) is closely related to that of emotion recognition, which is the ability to focus attention on nonverbal expressive cues to detect information about the expresser's emotional state. In our adapted Stroop task, emotion recognition is assessed with an important twist, namely the introduction of distracting information. This is likely to provide a somewhat more realistic task than do conventional tests of emotion recognition, in that judgments in everyday life are typically made during a stream of exposure to multiple sources of information. The conceptual meaning of tuning out of nonverbal cues (TONC) is a form of attentional deployment away from emotional stimuli, in order not to be distracted during information processing of stimuli other than nonverbal cues. In doing so, participants attempt to be uninfluenced by emotion cues that are typically highly salient in everyday life, due to the importance of nonverbal behavior in maintaining social relationships. It is important to be precise by referring to TONC as emotion attention regulation rather than emotion regulation per se, in the sense that participants themselves do not necessarily have internal affective experiences when viewing the test stimuli, and so the regulation of one's own emotions is not necessarily required. Rather, respondents need to block out the potential influence of these cues on their attention to a cognitive task. This is an important skill in social interaction, to the extent that the salience of nonverbal cues can be distracting from attempts to achieve other goals. As such, we argue that it is more precise to refer to TONC as a matter of attentional deployment. It is also important to emphasize that it is nonverbal cues that participants are tuning out. In our paradigm, participants' judgments are always tuning in to something and tuning out of something else—whether that something is nonverbal cues or alternate content.[1] In TONC, attention is meant to be deployed to the alternate content rather than to the nonverbal cues of emotion.

Although TINC and TONC are related to emotional abilities that have already been discussed under the umbrella of emotional intelligence—namely, emotion recognition and emotion regulation, respectively—we introduce emotion attention regulation as a theoretically novel construct. In doing so, we join recent attempts to specify fine-grained aspects of emotional abilities that are distinct yet related to the existing facets in dominant models. For example, Côté and Hideg (2011) introduced as a new facet of EI the ability to influence others via emotion displays, which involves a combination of emotional expression ability and social regulation. Likewise, we propose emotion attention regulation as a facet of EI that draws from existing facets while maintaining a distinct meaning.

This description of the difference between tuning in to and out of nonverbal cues attempts also to make the case that TINC and TONC represent theoretically distinct facets from each other, even though they both still fall within the new concept of emotion attention regulation. However, it is important to point out that we also expected these two constructs to converge. In general, facets of EI that are assessed using ability measures tend to converge—for example, emotion recognition with emotional expression (Elfenbein & Eisenkraft, 2010) and emotion recognition with emotion understanding (Thingujam, Laukka, & Elfenbein, 2012). This has been referred to as a positive manifold (Matthews, Zeidner, & Roberts, 2002), which is a valuable feature in that it suggests aspects of emotional functioning may be related as part of a coherent broader *g* of emotional intelligence. However, the convergence among facets of EI is imperfect. This is also a helpful feature, in that it suggests these factors are not merely redundant and that they are likely to represent different aspects of emotional functioning.

This article attempts to provide evidence for the validity of emotion attention regulation, namely tuning in to and out of nonverbal cues, and to introduce a new measure created to test it. In doing so, we follow the criteria established by Matthews et al. (2002) in terms of the four criteria they outlined that any purported approach to emotional intelligence should satisfy at least minimally. We review each of these criteria and how the present investigation attempts to address them.

First, a measure needs to demonstrate content validity. We attempt to satisfy this criterion with the arguments mentioned earlier, which attempt to make the case that tuning in to and out of nonverbal cues fit within umbrella models of emotional intelligence.

Second, a measure of EI needs to demonstrate reliability, in order to document that it can properly be considered an individual difference. Toward this goal, we present test–retest and split-half correlations. It is worth noting that the EI field has not typically reported reliability coefficients in terms of Cronbach's alpha. We speculate that this convention is due to the use of binary scores on a stimulus-by-stimulus basis, rather than the Likert response scales, for which alpha is more appropriate.

[1] We thank an anonymous reviewer for this point.

Third, a measure needs to demonstrate construct validity. We attempt to meet this criterion through convergence with existing measures of EI and through divergence from personality traits and the nonemotion Stroop (1935) task. Toward convergent validity, the study includes a large number of EI measures, with particular attention to those measures with objective responses, namely emotion recognition and understanding. We expected higher scores on these EI measures to be associated with lower interference and errors with the emotions Stroop. On an exploratory basis, we also included three other types of measures of EI: ability tests that use scoring on the basis of participant judgments, social perception measures that draw from the judgments made by observers closely acquainted with participants, and self-ratings that represent participants' self-perceptions even if not their objective abilities. Toward discriminant validity, also called divergent validity, we test a wide range of personality traits. The field of EI has often been accused of repackaging "old wine in new bottles" via conceptual overlap with existing personality traits (Mayer et al., 2008). As such, it is important to show that any assessment of EI is distinct from such traits (Joseph & Newman, 2010). To the extent that traits represent behavioral tendencies and preferences, we expected them to have minimal overlap with emotional abilities. That said, some traits are theoretically defined in terms of sensitivity to emotion stimuli—that is, neuroticism and anxiety—and we expected higher levels of these traits may be associated with greater interference and errors on the emotions Stroop. Likewise, we test divergence from generalized processing with a modern version of the Stroop task. This helps to establish that our measure is not merely confounded with more general processing speed and that it is truly about emotion.

Finally, a measure of EI needs to show predictive validity for relevant criteria. In this study, we focus on subjective well-being. Emotional abilities are in the service of social interaction, which is a central aspect of overall life functioning and satisfaction more generally (Mayer et al., 2008). We also focus on, in addition to the theoretical connection between EI and life functioning, this criterion to facilitate comparability with the existing literature on EI conducted with undergraduate student populations (e.g., Brackett, Rivers, Shiffman, Lerner, & Salovey, 2006), such as those populations accessible for the current study.

Method

Materials

The Tuning in to and Out of Nonverbal Cues of Emotion (TIONCE) measure consists of four sections: visual and auditory modalities that are each completed on the basis of two alternate instructions. Detail about the overall structure of the test was described earlier in the article. There is an auditory test examining emotional valence and a visual test examining approach–avoidance. In the auditory test, 11 positive and 11 negative words are spoken in positive and negative vocal tones, using stimuli validated in Sanchez-Burks (2002). The original list contained 34 words, and to reduce the length of the task, from this list we selected 11 positive and 11 negative validated words at random. There are equal numbers of trials in the 2 × 2 conditions of positive versus negative vocal tone and positive versus negative words. In the visual test, 14 green and 14 red colors appear on happy and angry facial expressions, using stimuli validated in Ekman and Friesen (1976). Likewise, equal numbers of trials appear in the 2 × 2 conditions of approach versus avoidance colors (green and red, respectively) and approach versus avoidance facial expressions (happy and angry, respectively).

Participants made judgments separately under two different instructions. As described earlier, in *tuning in to nonverbal cues* (TINC), participants identified the type of nonverbal cue. In the auditory modality, they indicated whether the vocal tone was positive or negative, regardless of the word's semantic meaning. In the visual modality, they indicated whether the facial expression should make a person want to stop or go, regardless of the picture color. In *tuning out of nonverbal cues* (TONC), participants identified the alternative information to the nonverbal cues. In the auditory modality, they indicated whether the semantic word was positive versus negative, ignoring the vocal tone. In the visual modality, they indicated whether the color should make a person want to stop or go, ignoring the facial expression.

Participants were asked to make their responses as quickly and accurately as they could. In order to examine a participant's level of distraction without confounding their overall accuracy on the test, in each section we standardized scores within-person around a mean of zero. This is conventionally done when using Stroop tasks to investigate individual differences (Faust, Balota, Spieler, & Ferraro, 1999).

Consistent with norms for analyzing data from Stroop tasks, there were two types of scoring: error rates and RT distraction scores (Balota et al., 2010; MacLeod, 1991). Error rates were the number of mistakes during incongruent trials, that is, when the positive versus negative valence of the word and vocal tone were mismatched with each other or when the stop versus go approach–avoidance dimension of the color and facial expression were mismatched with each other. Reaction time distraction scores were the difference in RTs between the incongruent and congruent responses. Note that higher values on the TIONCE indicate greater errors or greater distraction in RT, both of which indicate lower performance on the task.

Data for participants were dropped if they had error rates large enough to suggest noncompliance. A conservative 30% error rate was used for dropping data while maintaining all responses within normal individual differences—vis-à-vis an error rate of 50% from chance guessing alone. This led to 97% of data being included. The 30% criterion was applied separately to the four sections, and any participant meeting this criterion for at least one section was dropped from all analysis.

Participants

Four samples included a total of 412 participants. Samples 1, 2, and 3 consisted of college undergraduates ($N = 157$, $N = 57$, and $N = 122$, respectively) who participated for course credit. Participants in Sample 4 were part-time master of business administration (MBA) students who were employed full-time ($N = 76$). In order to assess test–retest reliability, we had those in Samples 2 and 3 complete the TIONCE on two occasions separated by approximately one week. In order to assess split-half reliability, during each session we had those in Sample 3 take a double-length version of the TIONCE, which included all trials two times.

Measures

A wide range of measures was used to test the four criteria for validity. In order to assess convergent validity, we included multiple measures of emotional intelligence (EI). There were four types of EI measures: (a) ability tests that were scored on an objective basis, (b) ability tests that were scored on the basis of the responses of either experts or a sample of other participants, (c) social perception measures, and (d) self-reported measures. Two ability tests used objective scoring. The Diagnostic Analysis of Nonverbal Accuracy (DANVA; Nowicki & Duke, 1994) includes tasks to identify the intended emotional states in facial expressions (Samples 1, 3, and 4) and vocal tones (Samples 1 and 3). Each scale contains happy, angry, fearful, and sad stimuli. Scores range from 0% to 100% on the basis of the number of responses that match the intended emotion category. Participants in Sample 3 completed the DANVA twice, once during each of their laboratory sessions. The Situational Judgment Test of Emotion Understanding (STEU; MacCann & Roberts, 2008) includes questions and scenarios that test understanding of emotional appraisal theory (Sample 4). Two ability tests used consensus scoring. The Situational Judgment Test of Emotion Management (STEM; MacCann & Roberts, 2008) includes judgments about the most desirable responses to scenarios related to managing emotions, and scoring is based on expert judgments (Sample 4). The Mayer–Salovey–Caruso Emotional Intelligence Test (MSCEIT; Mayer, Salovey, & Caruso, 2002) includes questions about perceiving emotion, using emotion, understanding emotion, and managing emotion (Sample 4). MSCEIT scores are based on consensus scoring from a sample of college undergraduates, which converges highly with consensus scoring on the basis of experts. Scores are normed to an average of 100 to match the rubric used for Cognitive Intelligence Tests, commonly called *IQ*. As a social perception measure of EI, abilities were judged by knowledgeable observers (Sample 4). Participants nominated peers from their actual full-time jobs with whom they said that they worked together closely. On a confidential basis, these peers completed the observer rating scale from Elfenbein, Barsade, and Eisenkraft (2015). That questionnaire is adapted for observer report from the Self-Reported Emotional Intelligence Scale (SREIS; Brackett et al., 2006), with responses rated on a 9-point scale ranging from 1 (*low*) to 9 (*high*). Self-reported EI was tested with the SREIS in Sample 4 and the Wong and Law Emotional Intelligence Scale (WLEIS; Wong & Law, 2002), with responses rated on a 7-point scale from 1 (*low*) to 7 (*high*), in Sample 1.

To examine divergent validity, multiple personality factors were tested. The Big Five traits of extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience were tested with the Big Five Inventory (John & Srivastava, 1999) in Sample 1, using a scale from 1 (*low*) to 5 (*high*), and the Ten-Item Personality Test (Gosling, Rentfrow, & Swann, 2003) in Samples 3 and 4, using a scale from 1 (*low*) to 7 (*high*). Additional personality traits that relate to affective and attentional processes were included. Sample 4 completed the Positive and Negative Affect Scale (Watson, Clark, & Tellegen, 1988), which assesses trait-level tendencies to experience positive and negative affective states, using a scale from 1 (*low*) to 5 (*high*). Sample 1 completed the State–Trait Anxiety Inventory (Spielberger, 1983), with a scale from 1 (*low*) to 4 (*high*). The Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), with a scale from 1 (*low*) to 5 (*high*), was completed by Sample 1. Divergent validity from generalized processing speed was examined with a modernized version of Stroop's (1935) original color–word task in Sample 1. The color–word Stroop task used here differed from the original in that, rather than presenting all stimuli in a block for participants to read out loud, as in the original task, a computer screen presented each stimulus individually, and responses were entered by keyboard.

We assessed predictive validity by having participants self-report their well-being with the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) in Samples 1 and 3, using a scale from 1 (*low*) to 7 (*high*).

The MBA students in Sample 4 reported their scores on the Graduate Management Admission Test (GMAT) as a proxy for cognitive intelligence (78% response rate), using the test's scale from 200 to 800. As part of their curriculum, these participants also completed unrelated measures that are not analyzed in the Results section.

Results

Tables S1, S2, and S3 in the online supplemental materials contain descriptive statistics and correlations for study variables in Samples 1, 3, and 4, respectively. Because Sample 2 completed only the TIONCE, for the purpose of assessing test–retest reliability, no correlation matrix is included.

Table 1 summarizes correlations among the four sections of the TIONCE. When examining error rates—the values below the diagonal—there are positive associations across all four sections, that is, the auditory and visual modalities each for TINC and TONC. This positive manifold suggests that these individual components are part of a higher order construct of emotional intelligence (Matthews et al., 2002). By contrast, the RT distraction scores—the values above the diagonal—do not appear to converge with each other.

We began analysis by examining reliability. Table 2 summarizes test–retest and split-half correlations for the TIONCE. Test–retest

Table 1
Correlation Coefficients Among the Multiple Segments of the Tuning in to and Out of Nonverbal Cues of Emotion Measure

Variable	1	2	3	4	5	6
Tuning out						
1. Faces	—	.09†	—	−.03	−.05	−.05
2. Voices	.20**	—	—	.06	−.05	.03
3. Overall	—	—	—	.02	−.04	.01
Tuning in						
4. Faces	.24**	.24**	.32**	—	−.04	—
5. Voices	.16**	.16**	.21**	.20**	—	—
6. Overall	.26**	.26**	.34**	—	—	—

Note. $N = 363$ on the basis of listwise deletion from the original sample of $N = 412$, after dropping data from participants with any sections in which error rates exceeded 30%. Data below the diagonal show correlations among error rates; data above show correlations among reaction time distraction scores. Dashes that are not along the diagonal indicate correlations not reported for the association of components with totals that include the components.
† $p < .10$. ** $p < .01$.

Table 2
Reliability of the Tuning in to and Out of Nonverbal Cues of Emotion Measure

Reliability	N	Overall	Tuning in to nonverbal cues			Tuning out of nonverbal cues		
			Overall	Faces	Voices	Overall	Faces	Voices
Error rate on incompatible trials								
Test–retest reliability	153	.62**	.63**	.46**	.62**	.41**	.33**	.40**
Sample 2	41	.59**	.68**	.51**	.56**	.16	−.02	.25
Sample 3	112	.63**	.61**	.42**	.64**	.51**	.34**	.41**
Split-half reliability	112	.59**	.50**	.31**	.61**	.42**	.24*	.44**
Replication of split-half	112	.70**	.67**	.49**	.64**	.54**	.33**	.49**
Difference in reaction time between compatible and incompatible trials								
Test–retest reliability	153	.10	.17*	.06	.21*	.06	.11	.07
Sample 2	41	−.08	.03	.10	.02	.00	−.02	.11
Sample 3	112	.21*	.23*	.05	.27**	.04	.15	.02
Split-half reliability	112	.14	.13	−.04	.21**	.10	−.01	.25**
Replication of split-half	112	.12	.10	.08	.12	.20*	.29**	−.03

Note. Split-half reliability and replication of split-half reliability assessed in Sample 3. In both samples, test–retest reliability was measured at an interval of approximately one week.
* $p < .05$. ** $p < .01$.

reliability was substantial for error rates on incompatible trials (average $r = .62$). Indeed, for Sample 3, which took the DANVA at both sessions, this value was comparable to test–retest reliability for the DANVA faces and voices scales ($r = .61$ and $r = .59$, respectively). Split-half reliability was assessed in Sample 3, which took a double-length version of the TIONCE on each occasion, and values were substantial for error rates ($r = .59$ and $r = .70$ for the first and section sessions, respectively). For RT distraction scores, by contrast, the apparent reliability was poor. Test–retest validity averaged only $r = .10$, and split-half reliability was $r = .14$ and $r = .12$ at the two sessions. For this reason, the following analyses focus on error rates rather than RT distraction. However, for completeness in presentation, the tables in the online supplemental materials include the same analyses for RT distraction scores.

Table 3 summarizes analyses of convergent validity between the TIONCE and other measures of EI. The correlations presented show that individuals with lower error rates on the TIONCE had greater accuracy on the DANVA faces test of emotion recognition ($r = -.26$) and had higher ratings of EI by close observers ($r = -.30$). Lower errors in tuning in to nonverbal cues (TINC) was associated with higher scores on the STEM test of emotion management ($r = -.29$). There was no apparent relationship between error rates on the TIONCE and scores on the MSCEIT test ($r = .04$) and likewise no apparent relationships with self-reported EI using the WLEIS ($r = -.11$) or SREIS ($r = .01$). Online supplemental Table S4 presents the same analysis using RT distraction scores.

Table 4 presents tests of divergent validity. Error rates on the TIONCE did show some associations with personality traits, although only one effect replicated across samples and was significant in aggregate. Participants with greater errors on the TIONCE tended to have higher neuroticism ($r = .13$). For some samples and some conditions of the TIONCE, there were also associations of errors on the TIONCE with lower agreeableness, lower openness to experience, lower conscientiousness, and lower extraversion. Anxiety was tested in one sample, and greater anxiety was associated with greater error rates in TONC. Error rates on the TIONCE were also distinct from generalized processing speed on the color–word Stroop task ($r = .00$). Online supplemental Table S5 presents the same analysis using RT distraction scores.

Table 5 presents tests of predictive validity. Individuals with fewer errors on the TIONCE reported greater life satisfaction ($r = -.19$). Online supplemental Table S6 presents the same analysis using RT distraction scores. To further examine the predictive validity of error rates, we aggregated data from Samples 1 and 3 and ran a multilevel regression that controlled for gender and the Big Five personality traits. This model also included a random effect for the two samples included, in case results may have differed across samples. In this model, the TIONCE remained a significant predictor ($\beta = -.14$, $p = .02$, 95% confidence interval [CI: −.25, −.03]). In separate models for the two types of instructions, TONC remained significant ($\beta = -.12$, $p = .03$, 95% CI [−.23, −.01]) and TINC was marginally significant ($\beta = -.09$, $p = .10$, 95% CI [−.21, .02]).

Table 6 presents associations with personal background characteristics. There was no association with gender ($r = .06$). For cognitive intelligence, tested only in the small Sample 4, there was a nonsignificant trend where higher GMAT scores were associated with lower error rates on the TIONCE. Online supplemental Table S7 presents the same analyses using RT distraction scores.

Discussion

This article takes a novel approach to a question of deep interest to psychologists: How can one establish that components of emotional intelligence (EI) are truly objective abilities? It has been challenging to develop measures that meet all the major validity criteria for EI. Self-report tests tend to converge highly with existing personality traits and have minimal predictive validity after controlling for these traits. Ability tests do better on this front, but construct validity is often qualified by the lack of objective criteria for correct responses (cf. MacCann & Roberts, 2008). Defining the correct answer in terms of consensus among lay

Table 3
Convergent Validity Between Measures of Emotional Intelligence (EI) and Error Rates on Incompatible Trials in the TIONCE Measure

Measure and sample	*N*	Overall	Tuning in to nonverbal cues			Tuning out of nonverbal cues		
			Overall	Faces	Voices	Overall	Faces	Voices
DANVA								
Faces scale	321	−.26**	−.32**	−.24**	−.24**	−.12*	−.06	−.12*
Sample 1	153	.22**	−.24**	−.17*	−.17*	−.09	−.05	−.08
Sample 3	112	−.40**	−.45**	−.35**	−.39**	−.25**	−.16†	−.25**
Sample 4	56	−.17	−.32**	−.29**	−.20	.06	.06	.03
Voices scale	265	−.06	−.06	−.02	−.06	−.05	−.03	−.05
Sample 1	153	−.03	.00	.08	−.08	−.05	−.07	.00
Sample 3	112	−.10	−.13	−.18†	−.04	−.06	.03	−.11
Situational tests (Sample 4)								
STEM	56	−.20	−.29*	−.18	−.29*	−.01	.02	−.05
STEU	56	−.04	−.14	−.12	−.11	.08	.08	.05
Observer-rated EI (Sample 4)	55	−.30*	−.28*	−.22	−.23†	−.16	−.01	−.22
Perceiving emotion	55	−.05	−.10	−.09	−.07	.04	.16	−.08
Use of emotion	55	−.22	−.19	−.10	−.20	−.15	−.13	−.11
Understanding emotion	55	−.24†	−.23†	−.19	−.18	−.13	−.04	−.16
Managing emotion of self	55	−.14	−.14	−.07	−.16	−.07	.07	−.15
Social management	55	−.27†	−.23†	−.24†	−.11	−.17	−.06	−.19
MSCEIT (Sample 4)	54	.04	.07	.01	.11	−.01	−.04	.03
Perceiving Emotions	54	.04	.06	.00	.09	.01	−.02	.03
Using Emotions	54	−.03	.12	.09	.09	−.17	−.15	−.12
Understanding Emotions	54	−.17	−.41**	−.45**	−.18	.16	.11	.15
Managing Emotions	54	.27*	.33*	.28*	.24†	.08	.03	.10
Self-rated EI								
WLEIS (Sample 1)	153	−.11	−.07	−.07	−.03	−.10	−.01	−.14†
Self Emotion Appraisal	153	−.05	.02	.04	−.01	−.09	.00	−.13
Other Emotion Appraisal	153	−.06	−.08	−.10	−.01	−.02	.07	−.10
Use of Emotion	153	−.07	.01	−.06	.07	−.11	−.08	−.08
Regulation of Emotion	153	−.11	−.11	−.05	−.11	−.06	−.02	−.06
SREIS (Sample 4)	56	.01	.06	.00	−.18	−.01	.29*	−.13
Perceiving emotion	56	.05	−.15	−.04	−.22	.23†	.34**	.00
Use of emotion	56	.04	.05	.17	−.12	.01	.13	−.14
Understanding emotion	56	.02	−.02	.04	−.08	.05	.18	−.12
Managing emotion of self	56	−.03	−.06	−.10	.02	.02	.15	−.15
Social management	56	−.08	−.21	−.13	−.21	.10	.07	.09

Note. TIONCE = Tuning in to and Out of Nonverbal Cues of Emotion; DANVA = Diagnostic Analysis of Nonverbal Accuracy; STEM = Situational Judgment Test of Emotion Management; STEU = Situational Judgment Test of Emotion Understanding; MSCEIT = Mayer–Salovey–Caruso Emotional Intelligence Test; WLEIS = Wong and Law Emotional Intelligence Scale; SREIS = Self-Reported Emotional Intelligence Scale.
† $p < .10$. * $p < .05$. ** $p < .01$.

participants is problematic because it focuses on the extent to which people are conventional. In doing so, consensus-based scoring cannot distinguish between people who are unconventional in effective versus ineffective ways. It is also problematic to use the consensus of so-called experts, because their judgments still involve interpretation, which is potentially subject to societal norms and idiosyncratic preferences. We attempt to add to the small number of EI measures that use truly objective answers. In doing so, beyond validating a specific measure, we argue that these results expand the evidence to validate the EI construct as a whole. Measurement of abilities should involve correct versus incorrect answers.

In attempting to tackle this question, we also introduce a novel construct within EI, namely emotion attention regulation (EAR). To measure EAR, we introduce the Tuning in to and Out of Nonverbal Cues of Emotion measure, which is adapted from the classic Stroop (1935) task. Whereas some other emotion Stroop measures examine distraction by emotion words while naming colors, we incorporated nonverbal cues of emotion as the medium for the stimulus materials themselves. In doing so, we created an auditory test of positive–negative valence and a visual test of approach–avoidance. For each modality, participants attempted to tune into nonverbal cues (TINC) while ignoring alternate content and also to tune out of nonverbal cues (TONC) while identifying alternate content. TINC can be conceptualized as a form of emotion recognition under distracting conditions, and TONC can be conceptualized as regulating one's attention to ignore the distracting influence of nonverbal cues. Emotion attention regulation involves regulating one's attention toward emotion-related stimuli. However, unlike the goal of conventional emotion regulation, the goal of EAR is not necessarily to adjust one's own internal state but rather to facilitate information processing. As such, emotion attention regulation is related to concepts already within the umbrella of EI, but it represents a theoretically distinct factor.

Using four samples that included 412 total participants, we satisfied each of the four criteria that Matthews et al. (2002) outlined to establish the validity of any purported measure of EI. First, in terms of content validity, we rely on theoretical arguments

Table 4
Divergent Validity of Error Rates on Incompatible Trials in the TIONCE Measure With Respect to Personality and General Processing Speed (EI) Measures

Trait and processing speed	N	Overall	Tuning in to nonverbal cues			Tuning out of nonverbal cues		
			Overall	Faces	Voices	Overall	Faces	Voices
Big Five personality traits								
Extraversion	321	−.02	−.03	−.08	.03	.01	.03	−.02
Sample 1	153	−.01	.02	−.02	.06	−.04	−.01	−.05
Sample 3	112	.06	.04	−.03	.09	.03	−.02	.06
Sample 4	56	−.17	−.32	−.29*	−.20	.06	.20	−.12
Agreeableness	321	−.10†	−.14*	−.06	−.15**	−.03	.05	.09†
Sample 1	153	−.17*	−.19*	−.09	−.18*	−.08	−.02	−.09
Sample 3	112	−.09	−.11	−.05	−.12	−.07	.08	−.18†
Sample 4	56	.07	−.08	.00	−.13	.19	.18	.11
Conscientiousness	321	−.07	−.05	−.07	−.01	−.08	−.11†	−.02
Sample 1	153	.00	−.01	−.08	.06	.02	−.06	.09
Sample 3	112	−.13	−.08	−.15	.02	−.17†	−.07	−.20*
Sample 4	56	−.17	−.11	.08	−.28*	−.14	−.28*	.08
Neuroticism	321	.13*	.11*	.03	.15**	.12*	.03	.14**
Sample 1	153	.10	.04	−.05	.11	.12	.06	.11
Sample 3	112	.21*	.19*	.12	.19†	.19*	.03	.27**
Sample 4	56	.08	.15	.06	.18	−.03	−.02	−.03
Openness to experience	321	−.01	−.04	−.05	−.01	.02	.07	−.04
Sample 1	153	.08	.07	.14†	−.05	.05	.07	.01
Sample 3	112	−.11	−.15	−.27**	.01	−.04	.02	−.08
Sample 4	56	−.02	−.09	−.17	.05	.06	.18	−.11
Additional traits								
Trait Positive Affect (Sample 4)	56	.03	.01	.16	−.17	.03	.08	−.03
Trait Negative Affect (Sample 4)	56	−.06	−.06	−.16	.09	−.03	.05	−.11
Anxiety (Sample 1)	153	.13	.04	−.06	.11	.16*	.10	.13
Mindfulness (Sample 1)	153	−.07	−.06	.02	−.11	−.04	.02	−.09
Generalized processing speed								
Color–word Stroop (Sample 1)	145	.00	.07	.03	.07	−.07	−.05	−.06

Note. TIONCE = Tuning in to and Out of Nonverbal Cues of Emotion; EI = emotional intelligence.
† $p < .10$. * $p < .05$. ** $p < .01$.

that EAR falls within a broader umbrella of emotional abilities. In terms of the second criterion, reliability, our findings establish that the error rates when judging incongruent stimuli in the TIONCE have substantial test–retest and split-half reliability.

To establish the third criterion—namely, construct validity—we examined the convergence and divergence of the TIONCE with respect to theoretically relevant criteria. First, we examined its association with other measures of EI. There were a number of associations in the predicted direction, namely that greater errors on the TIONCE predicted higher performance on these other assessments. However—with the exception of observer-rated EI—the effect sizes were not large and were nonexistent for some measures. We argue that the positive associations that did emerge are a promising indication that the TIONCE measures an underlying ability falling within the positive manifold of emotional intelligence. However, it is difficult to interpret imperfect correlations as necessarily a problem for the TIONCE. Our study does not speak to the validity of these other measures, which are presumably imperfect just as the TIONCE is. More important, our test is not meant to cover exactly the same theoretical ground as do these other measures—tuning in to and out of nonverbal cues are in a larger umbrella of EI, but they are not the same facets of EI tested by these other measures included earlier. TINC is similar to emotion recognition but differs in that stimuli appear with distrac-

Table 5
Predictive Validity of Error Rates on Incompatible Trials in the TIONCE With Life Satisfaction Measures

Variable	N	Overall	Tuning in to nonverbal cues			Tuning out of nonverbal cues		
			Overall	Faces	Voices	Overall	Faces	Voices
Life satisfaction	265	−.19**	−.14*	−.10†	−.11†	−.17**	−.07	−.18**
Sample 1	153	−.24**	−.17*	−.08	−.17*	−.20*	−.14†	−.13
Sample 3	112	−.13	−.10	−.13	−.04	−.15	.02	−.24**

Note. TIONCE = Tuning in to and Out of Nonverbal Cues of Emotion.
† $p < .10$. * $p < .05$. ** $p < .01$.

Table 6
Correlations Between Error Rates on Incompatible Trials in the TIONCE and Personal Background Measures

			Tuning in to nonverbal cues			Tuning out of nonverbal cues		
Variable	*N*	Overall	Overall	Faces	Voices	Overall	Faces	Voices
Female	320	.06	.04	.02	.03	.06	.09†	−.01
Sample 1	153	.16†	.10	.12	.02	.15†	.15†	.06
Sample 3	111	.07	.07	.00	.12	.03	.11	−.04
Sample 4	56	−.22	−.20	−.18	−.12	−.13	−.09	−.13
GMAT score (Sample 4)	46	−.20	−.10	−.08	−.09	−.19	−.21	−.07

Note. TIONCE = Tuning in to and Out of Nonverbal Cues of Emotion; GMAT = Graduate Management Admission Test.
† $p < .10$.

tion. TONC is a matter of deploying one's attention away from emotion regulation. These can be seen as distinct from the other facets of EI tested with our samples. Further, it is important to note that in the EI field even tests that are intended to measure the same construct often correlate with each other only moderately. For example, in our data, the correlation between the managing emotions branch of the MSCEIT and the STEM was only $r = .10$ and between the understanding emotions branch of the MSCEIT and the STEU was $r = .16$ (see Table S3 in the online supplemental materials). This suggests that the data presented here on the convergent validity of the TIONCE is within the range of effects found in research on EI.

Construct validity was also tested in terms of the divergence of the TIONCE from existing personality traits. Associations tended to be minimal, and the few that were significant did not typically replicate across samples. For the two exceptions, neuroticism and anxiety, we predicted potential associations on the basis of the theoretical foundation of these traits in terms of sensitivity to affective stimuli. As further evidence for the divergence of the TIONCE measure from unrelated concepts, it did not correlate with a modern version of the nonemotion Stroop (1935) task.

As to the fourth criterion for validity of an EI measure, we established predictive validity for subjective well-being. To the extent that emotional abilities are used in the service of social interaction, which is a key component of life satisfaction, it is valuable to show that the TIONCE has incremental predictive validity for well-being above and beyond the influence of gender and the Big Five personality traits.

One observation of the results is that—despite being theoretically distinct—tuning in to nonverbal cues (TINC) and tuning out of nonverbal cues (TONC) tended to have similar trends with respect to the findings described earlier. They were correlated with each other—even if imperfectly—at .21, .46, .52, and .13 in Samples 1, 2, 3, and 4, respectively. Having a positive correlation is consistent with the tendency for EI measures to show a positive manifold with each other. However, the magnitude of these correlations supports our argument that TINC and TONC represent theoretically distinct constructs within the umbrella of emotional intelligence.

We did not predict in advance that—unlike error rates—the difference in RT between responses for congruent and incongruent stimuli would show minimal reliability and minimal associations with the criteria discussed earlier. Although unexpected, this is consistent with the observation made by some researchers using the Stroop paradigm of an empirical regularity, whereby their results tended to be more robust when examining these error rates instead of RT differences (e.g., Balota et al., 2010; Perlstein et al., 1998).

This study has important limitations to address in future research. This is the initial study that introduces the TIONCE, and it represents the new construct of EAR, about which understanding is at only a preliminary stage. More research is needed, particularly using a larger domain of measures. Larger numbers of participants should be used, particularly for the constructs tested in Sample 4. The association between the TIONCE and cognitive intelligence shows a promising effect size, which is comparable in magnitude to the correlations with life satisfaction that were tested with larger samples. Just as a positive manifold among facets of EI is a positive feature, so too is it a positive feature for emotional intelligence measures to show convergence with cognitive intelligence (Côté, 2010). Further, predictive validity can be tested with respect to other important life criteria related to social functioning and personal goal achievement, particularly expanding the criteria beyond self-reports. To the extent that tuning in to and out of nonverbal cues are abilities that can be used toward effectiveness in stressful situations that involve the potential for attentional overload, the TIONCE may predict performance in such domains. For example, athletes and referees often perform in front of noisy crowds that produce unpleasant and distracting emotion stimuli.

Taken together, the results of this study suggest the promise of new approaches for EI. Emotion-laden tasks can have objectively right versus wrong answers. In attempting to introduce a new concept within emotional intelligence and to validate a task to measure it using objective criteria—namely a Stroop task that tests judgments of compatible and incompatible stimuli—we argue that demonstrating the validity for particular facets of EI also reflects on the validity of EI as a whole. We speculate that the best tests of EI use objective criteria to break off one facet at a time and match their methods to the particular facet. Over time, the field can move toward a goal of assembling a collection of assessments that span the conceptual space of EI—rather than to expect any one measure to do so. New approaches may be able to move the field of EI toward fulfilling the promise that underlies the excitement.

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