



## People who need people: Trait loneliness influences positive affect as a function of interpersonal context

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### ABSTRACT

Trait loneliness is associated with negative health consequences; understanding involved processes may elucidate its contributory role. Evolutionary and reaffiliative models associate loneliness with negative affect and dysregulated cortisol responding, while the social monitoring system model associates loneliness with heightened salience of social cues. We hypothesized that loneliness would be associated with greater negative affect and cortisol reactivity, comparing a negative-evaluative audience Trier Social Stress Test (“audience condition;”  $n = 55$ ) versus a no-audience control condition ( $n = 69$ ) in non-depressed young adults. Opposing hypotheses, multilevel growth curve models indicated that loneliness was not associated with negative affect or cortisol reactivity in the audience versus no-audience condition. Loneliness was, however, associated with greater positive affect reactivity in the audience versus no-audience condition. In particular, the positive affect subfacet “Interest” was heightened in the audience condition but blunted in the no-audience condition as a function of loneliness, echoing a social monitoring system model of loneliness.

### 1. Introduction

Humans have a basic need to experience reciprocal, satisfying social relationships (Baumeister & Leary, 1995) and deficits in this area have been shown to predict negative outcomes. Trait loneliness is the persisting, subjective perception of the discrepancy between one’s actual and desired social relationships (Peplau & Perlman, 1982), and is associated with increased negative emotions (Cacioppo, Hawkley et al., 2006) such as worthlessness, depression and rejection sensitivity (for review see, Heinrich & Gullone, 2006), as well as with negative health outcomes. Physical health correlates include weakened cardiovascular functioning (e.g., elevated total peripheral resistance and decreased cardiac output; Hawkley, Burleson, Bertson, & Cacioppo, 2003), dysregulated sleep (Cacioppo et al., 2002), and heightened stress reactivity (Hawkley et al., 2003). Negative mental health outcomes associated with loneliness include increased risk for anxiety and depression (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Ernst & Cacioppo, 1999) and risk for suicide (Stravynski & Boyer, 2001). Several theories make predictions regarding the function of loneliness that can be tested under conditions of laboratory based social stress, which may suggest pathways by which loneliness is associated with negative outcomes. In the present study, we examine the relationship of trait loneliness to affective and neuroendocrine responses to an explicitly

negative evaluative social challenge versus non-social control versions of the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) in young adults.

#### 1.1. Theories of loneliness

Here we briefly describe three relevant theories of loneliness and their predictions for responding to social stress. First, an evolutionary perspective of loneliness suggests that in social species loneliness evolved as an adaptive mechanism and is posited to produce an “aversive state” (Cacioppo, Cacioppo, Boomsma, 2014, p. 1), which elicits “social pain” (p.1056), feeling unsafe, heightened threat sensitivity and negative social information bias (Cacioppo, Hawkley et al., 2006) to signal deteriorating bonds, which in the short-term facilitates survival by guiding reaffiliative behavior (Cacioppo et al., 2014, 2015). Second, the reaffiliation theory extends this evolutionary perspective by emphasizing the motivation to reaffiliate (Qualter et al., 2015). In this model, cues of social disconnectedness activate adaptive cognitive processes (e.g., attention to social information both negative and positive), which trigger reconnecting behaviors. However, a maladaptive response to these cues can result in negative information bias, threat hypervigilance, continued withdrawal, and ongoing loneliness and negative affect (Qualter et al., 2015). Third, a social monitoring system

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perspective (Gardner, Pickett, Jefferis, & Knowles, 2005) focuses on the salience of the social context to loneliness. Similar to both the evolutionary and reaffiliation perspectives, this model proposes that lonely individuals are highly sensitive to social context, and possess enhanced processing and interpretation of socially salient information (Gardner, Pickett, & Brewer, 2000; Gardner et al., 2005; Pickett, Gardner, & Knowles, 2004).

These models share in common the view that the function of loneliness is to motivate individuals to reestablish social connections. Additionally, they emphasize that loneliness connotes sensitivity to social context, but they differ in what *valence* of social context is posited to be most salient. Whereas the evolutionary model highlights the contributory role of negative social information, the reaffiliation and social monitoring systems emphasize the adaptive role of attending to all social information, both positive and negative. One distinguishing factor between these two latter theories is that in the reaffiliation model an adaptive response leads to reconnection, whereas as unremitted loneliness, the focus of this paper, is associated with social threat hypervigilance and negativity bias not specified in the social monitoring system model. Collectively, these theories suggest that loneliness is associated with aversive feelings, which may make social interactions feel more threatening, particularly under negative evaluative social conditions.

### 1.2. Loneliness and affect

Dysregulated affect is implicated in several negative mental health outcomes associated with loneliness, including depression, and is thus of interest in understanding processes operating in loneliness. Both increased negative affect (mood states including hostility, fear, and sadness) and diminished positive affect (mood states including interest, joy, and activation; Egloff, Schmukle, Burns, Kohlmann, & Hock, 2003) are relevant to mental health outcomes (Pizzagalli, Jahn, & O'Shea, 2005), and have also been associated with loneliness (Ernst & Cacioppo, 1999; Heinrich & Gullone, 2006). Affective dysregulation in social settings such as a negative evaluative lab-based stress induction might be particularly relevant to loneliness, and the models of loneliness described above suggest predictions.

The aversive state of loneliness in the evolutionary model, contributes to threat-hypervigilance, and has been linked to depressed, negative mood, and increased fear of evaluation (Cacioppo & Hawkley, 2009; Cacioppo et al., 2014; Cacioppo, Hawkley et al., 2006; Cacioppo, Hughes et al., 2006) as well as dampened momentary positive affect in a social context (Roedel et al., 2014). According to the reaffiliative theory, loneliness in an adaptive mechanism activates reaffiliation; however, in a maladaptive mechanism reconnection behaviors are not triggered, instead negative mood states such as threat-bias, withdrawal, negative affect, and prolonged feelings of loneliness ensue (Qualter et al., 2015). Examined through a social monitoring system lens, lonely individuals find both positive and negative social information highly salient, which helps guide individuals to appropriate reinclusion behaviors (Gardner et al., 2000, 2005). Heightened salience for negative social context would suggest an association between loneliness and negative affect; however, predictions are less clear regarding attunement to social cues and positive affect outcomes. One possibility is that greater social salience might be reflected in measures of positive affect, particularly its facets activation and interest, identified through dynamic cluster analysis (Egloff et al., 2003). Thus, the social monitoring theory of loneliness hints that loneliness will be associated with heightened salience of and attunement to the social environment and perhaps greater engagement in the presence of others compared to when alone, captured by increased positive affective reactivity following social situations. Collectively, however, the above-described loneliness models provide more theoretical support for a hypothesis that loneliness will be associated with increased negative affect in general, and indirectly provide support for increased negative affect

reactivity under a socially stressful situation such as the present study's social evaluative challenge.

### 1.3. Loneliness and cortisol

The dysregulation of cortisol, one indicator of hypothalamic-pituitary-adrenal (HPA) axis functioning, is one hypothesized mechanism through which loneliness contributes to negative health consequences, potentially due to experiencing social situations as more threatening (Cacioppo et al., 2002). No studies examine loneliness and cortisol reactivity in the context of lab-based social threat, but in naturalistic settings, loneliness is associated with flattened diurnal cortisol rhythms (Doane & Adam, 2010), suggesting a pattern of chronic HPA-axis wear and tear. Additionally, prior day loneliness predicted heightened cortisol awakening responses the following day (Adam, Hawkley, Kudielka, & Cacioppo, 2006), a marker of anticipating challenges in the upcoming day (Wetherell, Lovell, & Smith, 2015). Further, during the transition to college, perceived coping ability moderated the loneliness-diurnal cortisol slope association: Loneliness was associated with flatter diurnal patterns in those with low perceived coping ability, but steeper, putatively healthier diurnal slopes in those with higher perceived coping ability (Drake, Sladek, & Doane, 2016). Finally, lonely individuals exhibited increased systolic blood pressure reactivity in response to the TSST compared to non-lonely individuals (Ong, Rothstein, & Uchino, 2012). Although the loneliness theories described here do not make direct hypotheses about cortisol reactivity, they generally suggest that social interactions are more threat-provoking for lonely individuals. Given that threat-provoking social evaluation has been shown to be a unique predictor of cortisol reactivity to lab-based manipulations in a meta-analysis (Dickerson & Kemeny, 2004), this suggests a hypothesis that loneliness will be associated with greater cortisol reactivity to lab-based social stress.

### 1.4. The present study

The present study examined the relationship of trait loneliness with affective and cortisol reactivity to a negative-evaluative Trier Social Stress Test with an audience evaluating performance (hereafter the "audience condition") versus a no-audience control protocol (hereafter the "no-audience condition") in non-depressed young adults. Previous research has examined the relationship between loneliness and affect in positive versus negative company (Roedel, Ha, Scholte, Engels, & Verhagen, 2016) but not when individuals were alone. The current paradigm allows examination of whether lonely individuals respond differentially in the presence versus absence of others. Based on theory and the evidence reviewed above, we hypothesized that loneliness would be associated with greater reactivity (i.e., indicated by greater curvilinear change in growth curve models) in negative affect and cortisol in the audience versus no-audience condition. We made no *a priori* hypotheses regarding loneliness predicting positive affect reactivity because there was not clear theoretical support across multiple models, although one model, the social monitoring system model, provides a basis for such a prediction.

## 2. Method

### 2.1. Participants

Introduction to Psychology students were recruited from a midsized, private midwestern university through an introductory psychology class offering course credit. Eligibility was determined based on mass-screening responses. Eligible participants were those at least 18 years of age who denied using nicotine, hormonal birth control, psychotropic or corticosteroid medications, and who denied all of the following: chronic health conditions, colorblindness, learning disability diagnosis, and history of head trauma (due to administration of cognitive tasks; data

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