



## Telomere length and procedural justice predict stress reactivity responses to unfair outcomes in African Americans



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### ABSTRACT

This experiment demonstrates that chromosomal telomere length (TL) moderates response to injustice among African Americans. Based on worldview verification theory – an emerging psychosocial framework for understanding stress – we predicted that acute stress responses would be most pronounced when individual-level expectancies for justice were discordant with justice experiences. Healthy African Americans ( $N = 118$ ; 30% male;  $M$  age = 31.63 years) provided dried blood spot samples that were assayed for TL, and completed a social-evaluative stressor task during which high versus low levels of distributive (outcome) and procedural (decision process) justice were simultaneously manipulated. African Americans with longer telomeres appeared more resilient (in emotional and neuroendocrine response—higher DHEAs:cortisol) to receiving an unfair outcome when a fair decision process was used, whereas African Americans with shorter telomeres appeared more resilient when an unfair decision process was used. TL may indicate personal histories of adversity and associated stress-related expectancies that influence responses to injustice.

### 1. Introduction

Psychosocial factors fundamentally contribute to disparities among racial groups in health status, including cardiovascular disease, metabolic illness, and cancer (for review, Major et al., 2013). Although there are several known pathways (McEwen, 2012), psychosocial factors are thought to be especially influential by altering biological stress processes. To reduce stress-related health disparities, it is critical to better understand how psychosocial factors influence the stress responses of racial minority individuals (Matthews and Gallo, 2011). In addition to affecting racial health disparities through chronic stress and “weathering” (Geronimus, 1992), psychosocial factors influence biological responses to acute or momentary stressors (Kudielka et al., 2007), which are increasingly recognized as contributing to stress-related illnesses (Lovallo, 2015) through connections to chronic stress arousal (Obrist, 2012).

Stress responses reflect characteristics not only of individuals (van Dammen et al., 2014) but also of the environment or context of stressful situations (Boyce and Ellis, 2005). In turn, social psychological approaches have increasingly coalesced on the use of so-called “inconsistency models” to explain how psychosocial factors connect to stress responses (for overview, Proulx et al., 2012). Inconsistency models hold that discrepancies between people’s expectations for social interaction and their actual social experience elicit stress responses and compensatory coping. One specific inconsistency model that might help explain racial health disparities is worldview verification theory (WVT), which posits that inconsistency between a preexisting expectation for justice and a lived experience of injustice can profoundly affect racial minority stress responses (Major et al., 2007; Townsend et al., 2010)

In this study, we consider whether the inconsistency predictions of WVT extend to racial minorities’ experience with procedural justice, concerning whether people view the rules, treatments, or policies

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affecting them as fair (Lind and Tyler, 1988). A pervasive view among scholars of both justice and public health is that healthy coping with stressful experiences can be bolstered by ensuring that there is procedural justice (e.g., Jackson et al., 2006), especially because fair treatment can communicate social belonging and respect, which may reduce stress (Lind and Tyler, 1988). Fair treatment may be especially vital when distributive justice – concerning the perceived fairness of outcomes and allocations – is lacking. Yet, a key prediction of WVT is that procedural justice may be helpful only for individuals who possess a strong expectation for justice. For individuals who carry low justice expectations, the experience of fair treatment may not be helpful, due to inconsistency with initial expectations for justice (Lucas et al., 2016; Townsend et al., 2010). Moreover, an alarming possibility is that procedural justice could negatively affect coping among individuals with low justice expectations, if fair treatment threatens an existing world view (Major et al., 2007). Evaluating predictions of WVT on racial health disparities is important because racial minorities disproportionately experience unfair social treatment, which could strengthen expectations for low social justice.

In most inconsistency framework studies, individual differences in expectancies are assessed by self-report measures, such as those that capture the extent to which an individual endorses the status quo or believes in justice (Lucas et al., 2016; Townsend et al., 2010). Self-report, however, may lack the fidelity needed to fully evaluate WVT in health disparities contexts. Because people are strongly motivated to endorse the status quo and believe in justice (Jost et al., 2004), self-report is likely biased by agreeable responding. An alternative or adjunctive approach is to assess individual differences using biological markers, which can provide unbiased indicators. Moreover, because they usually have low to moderate correlations with self report (Hellhammer et al., 2009), biological indicators could provide new insights in evaluating inconsistency frameworks.

Telomere length (TL) is a biological marker that may be especially useful in evaluating WVT. Telomeres are repetitive sequences of DNA at the ends of chromosomes that protect against degradation during replication. Telomeres lose base pairs (shorten) with cell division until chromosomes are functionally impaired and become genetically unstable, resulting in cell death (Blackburn et al., 2006). TL is determined by many factors (Blackburn et al., 2015) including psychological stress (Epel et al., 2004; Mathur et al., 2016), and particularly racial stressors (Chae et al., 2016). Shorter telomeres are also linked to an increased risk of stress-related illnesses that occur disproportionately in racial minorities (D'Mello et al., 2015). Evaluating TL as an outcome has suggested a pathway through which chronic adversity gets under the skin to contribute to illness (Epel et al., 2004). Yet, little research has evaluated whether TL predicts stress responses, including stress reactivity (Tomiyama et al., 2012).

We pose that through reflecting past exposure to chronic adversity, TL indicates a social expectancy-related individual difference among racial minorities. Guided by WVT, we further pose that TL-indicated individual differences modify response to procedural justice. To test this, we obtained a TL measurement from a community sample of healthy African Americans. Participants then engaged in a social-evaluative stress task, during which high versus low levels of distributive (outcome) and procedural (decision process) justice were simultaneously experimentally manipulated using a 2 × 2 design. We assessed the joint effects of TL and justice manipulations on both emotional and biological stress responses. Specifically, we considered effects on positive and negative affect (PA and NA), and on salivary cortisol and dehydroepiandrosterone (DHEA) reactivity. Cortisol is the primary catabolic hormone released by the adrenal gland in response to stress. DHEA and its sulfate (DHEAs) are co-secreted with cortisol from the adrenal gland and serve as precursors for androgenic and estrogenic steroids (Friess et al., 2000). In the stress literature, DHEAs may indicate biological resiliency to a stressful experience due to anti-glucocorticoid action (Crowley and Girdler, 2014). Moreover, DHEAs may

functionally overlap with TL in indicating repair and resilience responses. To date however, DHEAs has rarely been evaluated in psychosocial TL research (Epel et al., 2009), despite that DHEAs could be an indicator of an adaptive stress response among racial minorities. We focus on the ratio of DHEAs to cortisol, which provides a picture of stress resiliency that is more comprehensive than merely assessing cortisol (Sollberger and Ehlert, 2016).

Consistent with WVT, we hypothesized a 3-way interaction, in which incongruence between TL and procedural justice would determine responses to receiving an unfair outcome (low distributive justice). Specifically, we predicted that two outcomes—high NA reactivity and low DHEAs:cortisol reactivity—in response to an unfair outcome would be most pronounced among low chronic adversity (long TL) African Americans when an unfair decision process was used, whereas these responses would be most pronounced among high chronic adversity (short TL) African Americans with use of a fair decision process.

## 2. Method

This study was conceptualized and performed in tandem to an alternate consideration of this data (Lucas et al., 2016) after obtaining subsequently described measurements of TL through blood-spot collection. Procedures for recruiting participants, implementing the stressor task, and experimentally manipulating fairness are therefore identical to a previous description.

### 2.1. Participants

Participants were recruited from metropolitan Detroit via advertisements. Potential participants completed an online prescreen to determine eligibility; exclusion criteria were taking an interfering medication or having a pre-existing medical or psychiatric condition that would preclude undertaking a minor stress induction. A sample of 118 eligible African Americans (82 women, 36 men; aged 18–63,  $M = 31.63$ ;  $SD = 13.82$ ) provided informed consent and enrolled (Table 1). This sample size fulfilled the a priori recruitment goal of at least 25 observations per experimental condition, which is consistent

**Table 1**  
Sample Characteristics (N = 118).

Gender	
Male	36 (30.51)
Female	82 (69.49)
Age	
18–20	28 (23.73)
21–30	44 (37.29)
31–40	14 (11.86)
41–50	9 (7.63)
51–60	21 (17.80)
Over 60	1 (0.85)
Missing	1 (0.85)
Income	
Less than \$15,000	43 (36.44)
\$15,000–\$24,999	21 (17.80)
\$25,000–\$34,999	14 (11.86)
\$35,000–\$49,999	13 (11.02)
\$50,000–\$74,999	14 (11.86)
\$75,000–\$99,999	9 (7.63)
\$100,000 and above	3 (2.54)
Missing	1 (0.85)
Education	
Less than High School	1 (0.85)
High School/GED	54 (45.76)
Some College or Trade School	33 (27.97)
College Graduate	19 (16.10)
Professional/Advanced Degree	11 (9.32)

Notes: Percentages in parentheses may add to less than 100 due to rounding.

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