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Playing a rigged game: Inequality's effect on physiological stress responses

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ABSTRACT

High income and wealth inequality corresponds with high rates of various health and social problems. One possible factor that could be contributing to this correlation is stress experienced by those being treated unfairly in an unequal society. The present experiment attempted to simulate aspects of income inequality in a lab setting while recording several measures of stress. Participants ($n = 96$) were assigned to one of four groups and played a memory game against a confederate opponent to earn "money" to spend in a lab market. The four groups depended on the difficulty of the problems and the fairness of the game that they and their opponents experienced. Stress attitudes were assessed with the Short Stress State Questionnaire (SSSQ) and four physiological measures: salivary cortisol, medial frontalis and corrugator facial muscle EMG, heart rate, heart rate variability (HRV), and skin conductance levels (SCL). Cortisol levels and HRV scores were the highest in groups that competed in an unfair game regardless of the difficulty of the problem compared to the groups playing a fair game. The group playing an unfair game with hard problems (disadvantaged) also had elevated facial muscle activity indicating negative affect and reported higher distress on the stress questionnaire. The results of this experiment showed that experiencing inequality even for a short time elicited several stress responses even if the participant benefited from the inequality.

1. Introduction

Living in a country or community where there are wealth and income inequalities has been shown to correlate positively with a number of social, political, behavioral and health-related problems [50,52,58,59]. Inequality has shown positive correlations with rates of teen smoking [36], drug overdose [18], obesity [46], infant mortality and early death rates [57], depression [37], mental illness [35,56], homicide and incarceration rates [26], teen pregnancy rates [32], problems in child development [6] and lack of motivation to do well in life [45]. In a review of much of this research, Wilkinson and Pickett [58,59] show clearly that there is a strong positive correlation between a general "index of social and health problems" and the level of economic inequality found in a country—controlling for the country's average income. That is, what matters is not how wealthy or poor a country is overall but the extent to which a country's wealth and poverty are unevenly distributed across its citizens.

Although it is clear that economic inequality is associated with behavioral and health problems, scholars disagree about the explanation of these associations. The resource perspective sees inequality to be correlated to societal ills because resources are more unevenly distributed, and the marginal (health, behavioral) gains of a dollar are higher for people at the bottom relative to people at the top of the distribution [5]. The psychosocial perspective, by contrast, argues that inequality has effects that go beyond the resources available to individuals, and holds that inequality induces stress and interpersonal distrust, leading to divided societies [31,58,59]. Given the rising inequalities in many Western societies [44], it is important to know more about the psychosocial effects of inequality.

While factors that tie inequality to physical and mental health problems are certainly complex and interrelated, Wilkinson and Pickett [58,59] point out that many of these problems are related to stress [55]. It seems plausible, therefore, that inequality produces stress, which in turn has a negative effect on psychological and physical health. But how does inequality produce stress? One possibility is that when people who are relatively low in socioeconomic status interact with people who are relatively high in socioeconomic status, they experience unflattering social comparisons, perceived lack of social mobility, and shame—all of which have been shown to be elevated in societies with greater inequality [22,30]. As Paskov et al. [45] point out, this "status anxiety" is an important source of the stress experienced by people in unequal societies (see also [35]). If these interactions and social comparison are

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ever-present, then the stress responses are also persistent potentially resulting in damage to physical and mental health.

Consistent with this interpretation, there have been a number of laboratory studies investigating the effect of being in a socially threatening situation on physiological and psychological stress. In the Trier Social Stress Test or TSST [33], participants perform challenging tasks in front of critical judges. This activates the hypothalamic-pituitary-adrenal (HPA) axis, which is a hormonal system that regulates the body's reaction to stressful events by, among other actions, the synthesis and release of cortisol. Gruenewald et al. [20] used a modified version of the TSST and had college students prepare and give a speech and solve difficult math problems either alone or while being socially evaluated by a panel of judges. Participants answered pre and post questionnaires that evaluated emotions, anxiety, and shame as well as salivary cortisol levels. Those participants who were socially evaluated exhibited greater increases in shame and had lower social self-esteem and elevated salivary cortisol levels compared with those who performed the tasks alone. In addition, cortisol increases were greater in participants who reported greater shame and lower social self-esteem.

The idea that social threats are particularly stressful is also consistent with a meta-analysis conducted by Dickerson and Kemeny [12]. They summarized research on various stress-induction methods to determine which situations elicit the highest levels of physiological stress response as measured by levels of cortisol. They considered several models of stress induction including the social self-preservation theory, social-evaluative threat theory, and uncontrollability theory. Overall, they found that situations in which there was a social evaluative component were those that elicited the highest levels of cortisol. They suggest that people are inclined to preserve their "public" selves and to put that self in jeopardy through social judgment arouses the HPA axis and results in the release of cortisol (see also [10]).

It should be noted that the TSST and other laboratory stress-induction methods that have been used in previous research involve the threat of being negatively evaluated based on one's performance on a task. They do not necessarily tap into stress produced by inequality per se. The purpose of the present study, therefore, was to see whether a laboratory task that emphasizes the inequality between participants can also produce psychological and physiological stress. Such a finding would provide a more direct link between laboratory research on social threat and stress on one hand, and economic research on inequality and health on the other.

A challenge for the present research, then, was to create a laboratory task that in some small way mimics the effects of economic inequality in the world. Economic inequality is a product of many interconnected components and certainly not all of them are replicable in a laboratory setting. Frank [17] points out socioeconomic success is to a large degree a product of chance events. Having the good fortune of wealthy parents, living in a rich country, surrounding oneself with other fortunate people all play an exceedingly large role in many people's success. This is not to say that there is no role for ability and hard work, but if one starts with good fortune that gives advantages, a path to success is made much easier. Therefore, we created a competitive multi-trial game where success is based to some degree on skill and effort, while also having an extremely powerful luck component. Some participants are randomly assigned to be relatively advantaged compared to their opponent (the game is made easier for them), and others are randomly assigned to be relatively disadvantaged (the game is made more difficult). To add the social judgment component, the advantages and disadvantages afforded each player and ultimately the changing economic status is made explicit to both competitors during the competition.

The hypothesis is that threat to the "social self" of those who are disadvantaged in the game will result in an increased stress responses compared with those who are advantaged and to those who are neither disadvantaged or advantaged relative to their opponent. Stress responses were measured in several ways. Psychological stress was measured by the SSSQ administered pre and post competition and has been shown to be sensitive to different components of an experience including distress, engagement, and worry. Physiological measures including facial EMG, heart rate and skin conductance were taken on a trial-by-trial basis to measure immediate distress and arousal responses during the competition. Heart-rate variability was analyzed at the beginning, middle and end of the competition, and salivary samples to evaluate cortisol were taken at the beginning and end.

2. Methods

2.1. Participants

Ninety-six participants (48 males and 48 females) were selected from the California State University, Fresno introductory psychology subject pool, and various psychology courses. Ages ranged from 18 to 25 years and all participants received class credit for participating. The socio-economic status of each participant was not recorded for each participant, but students at Fresno state typically come from middle to lower income families, with 74% of the students receiving financial aid for economic reasons. The full experimental protocol was reviewed and approved by the three members of the Psychology Department's Internal Review Board and was classified as a minimal risk.

2.2. Experimental design

Each participant played a delayed match-to-sample task (DMTS) against a confederate (the "opponent") played by a research assistant. Having a confederate created a sense of competition and social judgment, but also allowed for greater control of the competition. There were an equal number of male and female opponents, and the pairing was balanced across groups (i.e., equal number of male/male, female/female, male/female and female/male pairings). Saliva samples for cortisol analysis were taken before and after the competition, electrocardiogram (ECG) for heart rate (HR) and heart-rate variability (HRV) analysis, skin conductance level (SCL), and facial electromyography (EMG) were recorded during gameplay. The study used a between-subjects 2 × 2 design with participants randomly assigned to either a fair version of the task with either low or high difficulty or an unfair version with low or high difficulty. The participant and the opponent each took turns solving a DMTS problem with each being able to see the other's problems as well as their respective feedback. Participants were assigned to one of the following groups:

Unfair-Hard: The participant was given difficult problems to solve while the confederate opponent received easy problems.
Unfair-Easy: The participant was given easy problems to solve while the confederate opponent received difficult problems.
Fair-Hard: The participant and the confederate opponent were given equally difficult problems to solve. The participant in the *Fair-Hard* condition received the same problem set in the same order as the participant in the *Unfair-Hard* condition.
Fair-Easy: The participant and the confederate opponent were given equally easy problems to solve. The participant in the *Fair-Easy* group received the same problem set in the same order as the participant in the *Unfair-Easy* group.

Table 1 shows information about each group. To ensure there was not an order effect of running groups, a participant running sequence was created in advance. Each of the four possible sex-pairing combinations within each group was assigned a randomly generated number between 0 and 1 and the order of running was arranged from the lowest to the highest random number. If, however, a female signed up for a time slot where a male was needed, then that female participant was run in the next available female time slot and vice versa.

The DMTS game was programmed using the stimulus software by *E-*