Short Communication

Social identification and contagious stress reactions

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A B S T R A C T

Contagious stress describes the transmission of stress from a stressed person to an observer, which we examined at the neuroendocrine and the affective level. We tested whether a shared social identity moderates contagious stress. Ninety-four participants participated in groups of four. After inducing either a shared social or a personal identity, participants observed a confederate undergoing the Trier Social Stress Test (TSST), a standardized social-evaluative stressor. Salivary cortisol and affective stress were assessed multiple times before and after the observation of the TSST. We found a physiologically significant contagious stress reaction on a neuroendocrine level for 17% of all participants. Additionally, we found an increase in observers' self-reported stress. Contrary to our expectations, the manipulation of social identity had no effect on contagious stress. Our variation of the TSST is a viable methodological strategy to increase standardization as well as experimental economy in studies examining contagious stress.

1. Introduction

The phenomenon of experiencing affective and physiological stress merely by observing other people in stressful situations has been, among others, dubbed stress contagion (Dimitroff et al., 2017; Ebisch et al., 2012), contagious stress (White and Buchanan, 2016), resonance of stress (Buchanan et al., 2012) or empathic stress (Engert et al., 2014). Although all terms refer to the transmission of physiological stress reactions from a stressed person to an observer, a consistent terminology has not yet been agreed on (see White and Buchanan, 2016 for a helpful discussion of the different concepts and a distinction between empathy and stress contagion). Moreover, most terms imply different underlying physiological and behavioral mechanisms and situational characteristics. By definition, contagious stress describes the transmission of a physiological stress response in an individual observing a target who is undergoing a social-evaluative and uncontrollable situation, while the observer is watching the situation but is neither undergoing the same stressor, nor anticipates doing so in the future (e,g., Engert et al., 2014). In this paper, the term contagious stress is used, as it is descriptive and does not imply specific psychological mechanisms (e.g. mimicry, Hatfield et al., 1994) that were not in the scope of the current paper.

Previous research has found evidence for physiological contagious stress on a neuro-endocrine level (Buchanan et al., 2012; Engert et al., 2014). However, to the best of our knowledge, affective contagious stress has not yet been studied in combination with physiological contagious stress using controlled laboratory stressors. As stress is a multidimensional construct it is, however, necessary to examine not only its physiological but also its psychological dimension to achieve a comprehensive understanding (Frisch et al., 2015a). One moderator of contagious stress has been identified: contagious stress occurs with greater likelihood between dyads of romantic partners as opposed to dyads of strangers (Engert et al., 2014) and mothers showed more contagious stress when observing their own child, as compared to observing an unknown child (Manini et al., 2013). We argue that the social identity approach (SIA; Tajfel and Turner, 1981; Haslam et al., 2009) might be a key to understanding such moderation of contagious stress. The SIA proposes that being a member of a social group (and identifying with this group) becomes an integral part of one's self-concept (Tajfel and Turner, 1981; Haslam et al., 2009). Hence, when a group member observes another group member facing a social-evaluative stressful situation, it poses a threat to the observer's self-concept. Following social self-preservation theory (Dickerson et al., 2004) this threat is likely to produce a considerable stress reaction in the observer.

2. Present study

Following previous findings (Engert et al., 2014), we expect to find a physiologically significant increase in cortisol levels after observing a target (confederate) in a stressful situation in at least 10% but below 25% of all observers. Engert et al. (2014), found a physiologically significant increase in cortisol levels in 10% of the observers in complete stranger-dyads. We expected to find a somewhat higher response rate, as the manipulation of both personal and social identity requires some

degree of social interaction (that might have produced a foundation for increased empathy) prior to the stress observation situation. In the video observation condition in Engert et al. (2014), a response rate of 24% was found. However, this response rate combines dyads of strangers and romantic couples, hence we expected a somewhat lower response rate in our study. We also expect affective stress responses in the observers. Finally, sharing a social identity should increase both, endocrine and affective contagious stress, as compared to conditions in which a personal identity is salient. We argue that a shared social identity partly explains the previous findings that observing a target close to us (e.g. partner) as opposed to an unknown target enhances contagious stress (e.g., Engert et al., 2014). In general, examining potential moderators of contagious stress such as social identity contributes to a better understanding of psychological mechanisms underlying this phenomenon, informing about when and why contagious stress occurs.

The present study also proposes a new methodological strategy to examine contagious stress: all participants watched a videotape (which is presented to be a live transmission) of a confederate undergoing a stressful situation. To the best of our knowledge, this is the first study using a confederate as a TSST target. Doing so increases the standardization of the observed situation, particularly the stress reaction of the target. This allows for drawing better comparisons across target-observer-dyads.

Our study is designed to contribute to both, theoretical devolvement, as well as methodological advancement of contagious stress research. Besides the replication of previously reported effects, we propose a new economical approach to study contagious stress, extend the analyses of contagious stress reactions to affective stress and test a moderator derived from a strong theoretical framework.

3. Method

3.1. Participants and design

Ninety-four primarily Caucasian undergraduate students (46 females, M = 24.4 years, SD = 3.88) were studied in a 2-factorial design with random assignment to the experimental condition "identity manipulation" (2 levels: social vs. personal, between-subject factor) and a within-subject-factor of repeated measurements (4 levels for cortisol and 5 levels for self-reports). Test power calculations (G*Power 3.1.9.2; Faul et al., 2009) showed that the sample size is sufficient to detect medium effects (w = .3) with alpha = 0.05 and power = .80. The following exclusion criteria applied: pregnancy; use of medication containing cortisone; use of hormonal contraceptives; acute and chronic psychiatric, endocrine, cardiovascular, or other diseases; smoking and intake of psychoactive drugs. Participants had to abstain from alcohol, caffeine or other drugs or medications 24 h prior to the experiment. Participants were made aware of the exclusion criteria and requirement for substance abstinence during participant acquisition. Additionally, we counterchecked participants' compliance with a brief questionnaire at the end of the experiment. To control for the circadian rhythm in cortisol secretion (Kirschbaum and Hellhammer, 2000), all experimental sessions were scheduled between 02:00 and 05:00 PM.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the local ethics committee. All participants gave their written informed consent.

3.2. Materials

3.2.1. Social identity versus personal identity manipulation

Following previous studies, (Häusser et al., 2012; Frisch et al., 2015a,b) a shared social identity was induced by emphasizing participants' similarity and fostering their sense of community as a group (e.g., participants wore T-shirts of the same color, sat at a shared table and had to write down similarities with the other participants). In contrast, in the personal identity condition participants' interindividual

differences and personal characteristics were emphasized (e.g., participants wore T-shirts of different color, sat at individual tables and had to write down what distinguished them from the other participants). A detailed protocol and video instruction for the manipulation of identity can be found in Frisch et al. (2015a,b).

3.2.2. Stress induction

Social-evaluative stress was induced using the Trier Social Stress Test (TSST) (Kirschbaum et al., 1993). To increase standardization, videos of either a male or female confederate undergoing the TSST were recorded and shown to the observers (two male and two female confederates were used in the study). Because confederates were confronted with the TSST repeatedly (two video takes) during the recordings, were informed about the TSST tasks in advance and were familiar with the TSST committee members, we needed to ensure that the TSST would still be uncontrollable for the confederates to a certain degree. Therefore, we slightly modified the protocol in two ways:

(1) Confederates did not choose the job they wanted to apply for themselves. Instead, the TSST committee specified a job (e.g., press officer) immediately before the beginning of the interview (see Allen et al., 2017 for a similar procedure). This procedure was not visible in the videotapes shown to the observers.
(2) To preclude learning effects, the starting number and the subtrahend in the mental subtraction task were changed in every video take.

To verify whether the TSST elicited a physiological stress response, confederates' salivary cortisol levels were compared before and after undergoing the TSST. For all confederates, analyses showed a physiologically significant increase in salivary cortisol levels of at least 1.5 nmol/l as defined by Miller et al. (2013). Thus, the prerequisite criterion to elicit contagious stress in observers (i.e., stress in the target person) was met. Additionally, we assessed whether participants actually perceived the confederates as being stressed while undergoing the TSST: after the observation of the TSST, participants indicated which emotions the observed confederate experienced by choosing from a list of 15 different emotions (e.g. stress, sadness, joy). In total, 92 of 94 participants indicated that they believed that the observed confederate experienced stress.

To avoid artifacts resulting from the confederate's gender, male and female confederates were evenly distributed across experimental conditions. In the social identity condition 25 participants (11 female) observed a male and 23 participants (11 female) a female confederate. In the personal identity condition 24 participants (13 female) observed a male and 22 participants (11 female) a female confederate.[1]

3.2.3. Salivary cortisol

Saliva samples were obtained using Salivette® sampling devices (Sarstedt, Nümbrecht, Germany). All samples were analyzed in duplicates within one lot of reagents. A commercial enzyme-immuno-assay was used (IBL, Hamburg) and analyses were completely automatically processed on an analyzer (BEP2000, Siemens, Eschborn). Intra-assay coefficient of variation was below 3% and inter-assay below 5%.

3.2.4. Affective stress

Affective stress reactions were measured using the 'Stress Arousal Adjective Check List' (SACL; King et al., 1983). Using a 4-point-likert-scale (with 1 indicating "definitely not" and 4 indicating "definitely") participants rated their feelings of stress and arousal for a set of 20 related adjectives (e.g.: "distressed", "nervous"). Cronbach's α varied between 0.85 and 0.90 at the four times of measurement.

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[1] No gender effects were found for gender of confederate (target) or gender of participants (observer).
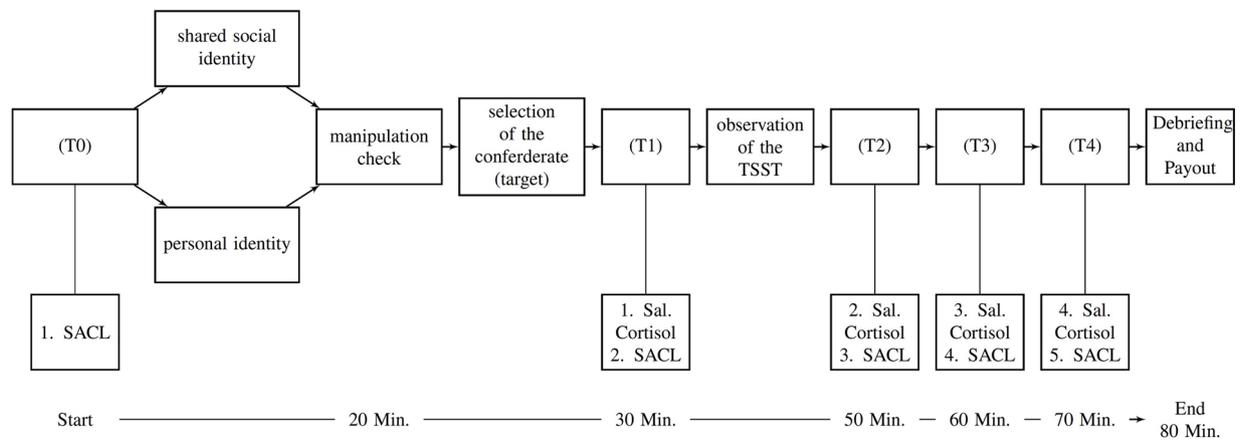
Fig. 1. Overview of the experimental procedure.

3.3. Procedure

Two female and two male participants plus the confederate, who pretended to be a participant as well were invited to each session.

First, participants filled in the SACL (T0). After inducing either a shared social or a personal identity, participants filled in a manipulation check consisting of four items with a 7 point-likert-scale regarding the participants' group identification (e.g., "I feel strong ties with other members of this group", with 1 indicating "not at all" and 7 indicating "complete agreement"). This scale showed good internal consistency (Cronbach's α = .82).

Next, in a bogus drawing of lots, the confederate was selected to take part in the TSST. To avoid anticipatory effects that could result in a possible stress reaction, participants only learned about the TSST immediately before the drawing of lots. The selected confederate left the room to allegedly prepare for the upcoming TSST. Meanwhile, the first saliva sample was obtained and a second measure of the SACL (T1). Seated at individual tables in separated cubicles, participants then watched the prerecorded videotape showing the confederate undergoing the TSST. Suspicion checks at the end of the experiment were conducted. In two questions with an open answering format participants were asked (1) about the assumed goal of the study, and (2) whether there was anything suspicious about the experimental procedure. None of the participants reported anything related to the actual goal of the study, doubted the live video transmission or identified the target to be a confederate. Further saliva samples and SACLs were obtained immediately after the TSST (T2), 10 min after the TSST (T3) and 20 min after the TSST (T4). Finally, participants were debriefed and paid €12 for their participation. See Fig. 1 for a detailed overview of the experimental procedure.

4. Results

4.1. Manipulation checks

Participants in the social identity condition reported significantly higher levels of group identification ($M = 3.85$, $SD = 1.13$) than participants in the personal identity condition ($M = 3.11$, $SD = 1.13$); $t(92) = -3.15$, $p = .002$, $d = 0.65$.

4.2. Salivary cortisol

Using delta-scores between times of measurement, we adopted the analytical strategy from Engert et al. (2014) and examined the ratio of participants that showed a physiologically significant increase in cortisol from baseline (T1) to peak (T2), and tested whether this ratio differed between experimental conditions. A total of 47% of all
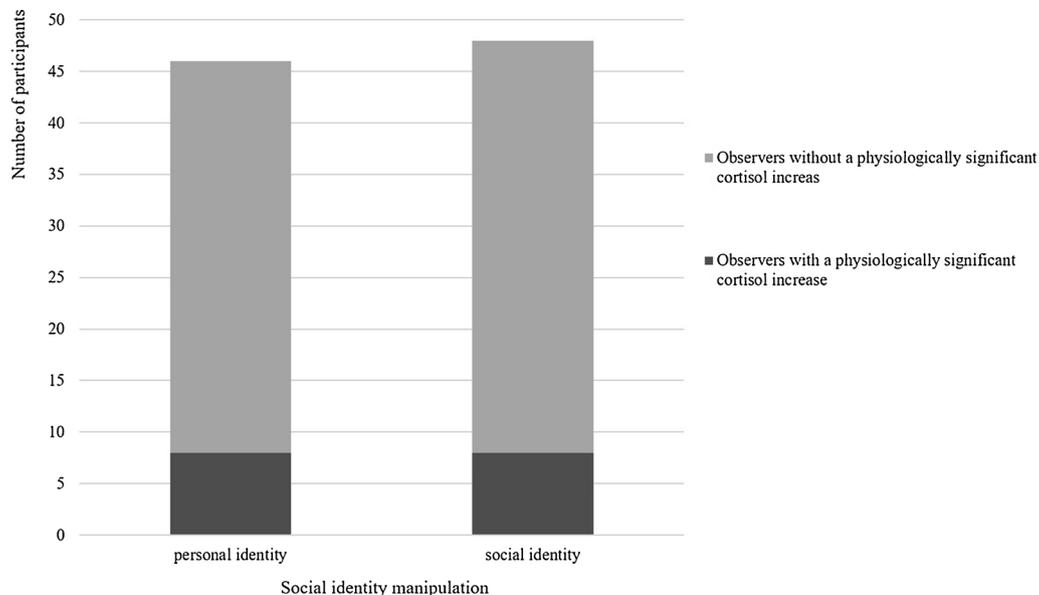

Fig. 2. Ratios of observers responding with physiologically significant cortisol increases (> 1.5 nmol/l) after the observation of the confederate undergoing the TSST by experimental condition.

participants showed an increase in cortisol levels after observing the confederate in the TSST (any increase from baseline at T1 to peak at T2) and a total of 17.0% (N = 16, see Fig. 2) of all participants showed a physiologically significant increase in cortisol levels higher than 1.5 nmol/l as defined by Miller et al. (2013). Importantly, the ratio of physiologically significant contagious stress reactions was similar in the social (n = 8; 16.7%) and personal identity (n = 8; 17.4%) conditions ($\chi^2 = 0.09$, $p = .571$, $BF_{01} = 5.20$, see Fig. 2).[2]

4.3. Affective stress

Due to missing values in the SACL for four participants, analyses included 90 participants. In contrast to cortisol, no cut-off values exist to determine a (psychologically) meaningful stress reaction for the SACL. A 2 (social vs. personal identity) × 5 (time of measurement) ANOVA with repeated measures revealed a significant main effect for time of measurement, $F(4, 352) = 16.38$, $p < .001$; $\eta^2 = 0.174$. In particular, we found a significant increase in affective stress from pre-TSST (T1, M = 1.92, SD = 0.51) to post-TSST (T2, M = 2.07, SD = 0.57), $t(93) = -2.95$, $p = .004$, d = 0.3. However, no main or interaction effects were found for the identity manipulation (all $ps > .26$).

5. Discussion

+-We replicated Engert et al.'s (2014) findings showing that observing another person undergoing a TSST can elicit physiologically significant contagious stress on a neuro-endocrine level. As predicted, contagious stress was found in more than 10% of the observers. Engert et al. found a response rate of 10% in the stranger condition, the response rate in our study was 17%. In contrast to Engert et al., participants in our study were no complete strangers and spent at least 20 min in one room together (personal identity condition) or even focused on shared similarities (social identity condition). Additionally, the selection of the confederate in a bogus drawing of lots might have contributed to this result. As they were made to believe that they could have been the one selected to undergo the TSST, their empathy for the confederate may have been increased. Although the occurrence of contagious stress was even slightly more likely than could have been expected in light of earlier research, it has to be admitted that only a minority of participants showed this reaction. Hence, while contagious stress is one possible psycho-physiological consequence when observing others in distress, it might not be the predominant one.

Additionally, we found first time evidence for an increase in observers´ self-reported stress from pre-TSST to post-TSST, indicating also affective contagious stress. By showing that not only endocrinological but also affective stress reactions are elicited by observing a stressed target, we broaden the concept of contagious stress. We encourage future studies to pursue this avenue and –going beyond this– to also examine behavioral consequences of contagious stress.

Contrary to our expectations, a shared social identity between observer and target did not amplify endocrine or affective contagious stress. Hence, social identity might not explain higher degrees of contagious stress in dyads with low social distance between observer and target, as found in earlier research (Manini et al., 2013; Engert et al., 2014). However, it has to be admitted that the brief laboratory manipulation of social identity is not sufficient to model the extent of shared social identity present in a partnership or parent-child-relationship. In line with this, Sbarra and Hazan (2008) emphasize the importance of adult attachment in psycho-physiological coregulation (and vice versa). Hence, adult attachment and a history of psycho-physiological coregulation might be more relevant in contagious stress in partners or relatives. Although manipulation checks showed that the manipulation of identity did produce different levels of group identification, it is possible that group identification was not yet strong enough; consequently, the observed situation might not have posed a threat to the observers' self-concept. Future studies examining social identity as a moderator of contagious stress might use existing social identities (e.g., group memberships) as quasi-experimental operationalizations. Moreover, specific aspects of a shared social identity might be particularly relevant for the case of contagious stress, for example social proximity. According to the Social Baseline Theory (Beckes and Coan, 2011), social proximity is an important interpersonal factor regulating physiological stress responses.

An additional aim of the present research was to introduce a new methodological strategy for research on contagious stress. Our results suggest that altering the classical contagious stress paradigm by showing prerecorded videotapes (that were announced as live transmissions) is a viable methodological strategy to increase standardization as well as experimental economy: we found that the TSST reliably elicits a physiologically significant stress response in its observers even if confederates undergo the TSST. The response rate was even higher as compared to the original study by Engert et al. (2014) that used naïve participants as targets. Due to prerecording of the videos our approach is clearly more economical, as it does not require a TSST committee to be present at the testing sessions. However, when examining contagious stress in terms of increased cortisol responses it is mandatory that all confederates show a physiologically significant increase in salivary cortisol. To achieve this, the modified TSST protocol as described in the method section can be applied. Alternatively, participants naïve to the TSST can be recruited for the production of the video material. Moreover, while the presence of a target (confederate) was necessary for the social identity manipulation in the present study, future studies that do not require the presence of a confederate prior to the TSST can increase experimental economy even further.

This new TSST version with prerecorded videos and confederates might prove to be useful in future studies examining further potential moderators of contagious stress (e.g., personality traits, state empathy) or in studies examining stress perception (e.g, visual cues in the perception of stress). In a nutshell, our study advances research on contagious stress by a) providing evidence for the stability of the basic finding by Engert et al. (2014), that endocrinological stress reactions can occur even between strangers in video transmitted situations, b) providing evidence for affective contagious stress reactions, c) suggesting a new and economic contagious stress paradigm, and d) testing a moderator from a strong theoretical framework.

Conflicts of interest

All authors declare that they have no conflicts of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.psyneuen.2018.11.034.

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[2] Because one central aim of the present study was to replicate Engert et al.'s (2014) findings we adopted their analytic strategy. We would like to thank the anonymous reviewers who sus'ggested reporting additional ANOVAs with repeated measures or area under the curve. A 2 (social vs. personal identity) × 4 (time of measurement) ANOVA with repeated measures revealed a significant main effect for time of measurement, showing an overall decline in levels of salivary cortisol. No main or interaction effects were found for the identity manipulation. Area under the curve analyses did not reveal significant effects for identity manipulation, either. These analyses are reported in detail in the supplemental online material.

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