Cortisol Levels and Experiencing of Flow: Are They Related? A Study with Seven Different Interventions

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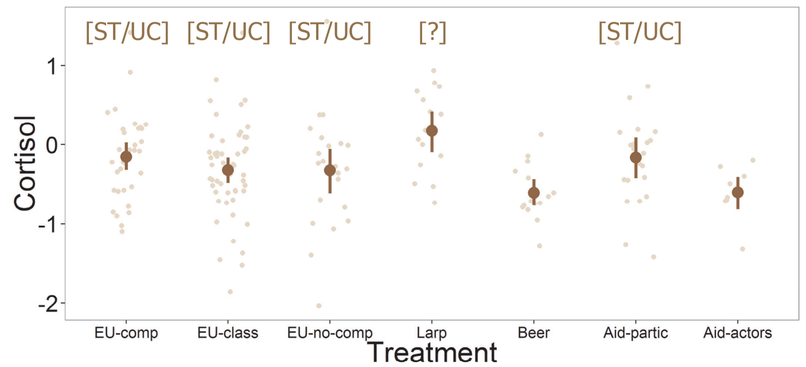
Introduction

The role of the glucocorticoid hormone cortisol in stressful situations has been widely studied in humans (see Dickerson and Kameny, 2004). Less is known about the engagement-cortisol relationship. Flow state is one possible conceptualization of engagement, often defined as a pleasant absorption by an undergoing activity. So far, only a few studies investigated the flow-cortisol link; with mixed results (Keller et al., 2011; Peifer, 2012; Peifer et al. 2014). Previously, it has been hypothesized that a) flow is positively related to elevated cortisol (Keller), b) the flow-cortisol relationship can be described by an "inverted U" function (Peifer). We designed a study, in which we attempted at dissociating flow and elevated cortisol: in order to demonstrate that cortisol is moderated by treatments' and personal characteristics but that there is no general flow-cortisol relationships.



Variable	Males	Females	Both
RCI.Comp	-.23(54)	.08(39)	-.18.(93)
RCI.Cont	**-.31*(**54)	-.20(39)	**-.28****(93)
Flow	-.24.**(**62)	.09(46)	-.11(108)
SIAS	**.40****(62)	.14(47)	**.31*****(109)
PANAS-	**.52*****(62)	.11(46)	**.30*****(108)

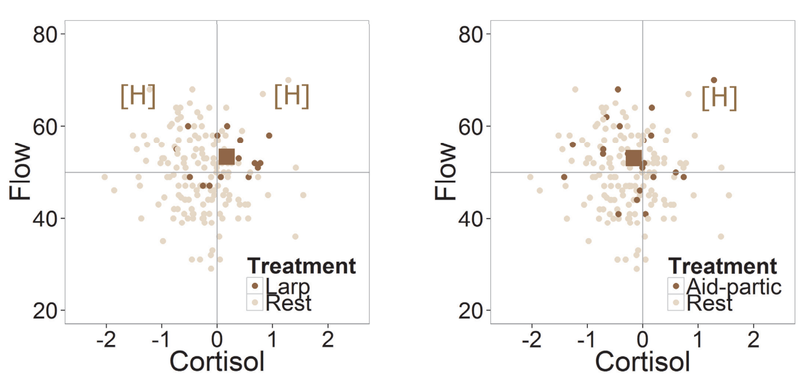
Methods

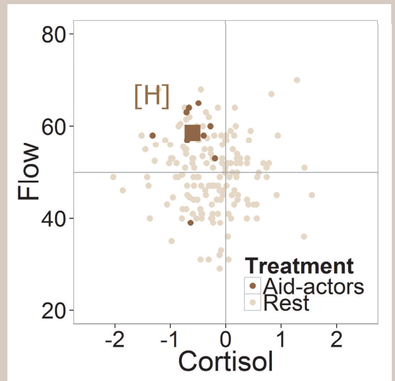
We used six different serious game-based treatments with seven different participant groups (N = 193; adults and adolescents). The interventions were designed to generate different levels of flow and cortisol responses, primarily because some were for a single user, but others were team-based, featuring so-called social-evaluative threat (ST) and uncontrollability (UC) components, known to be stressful:

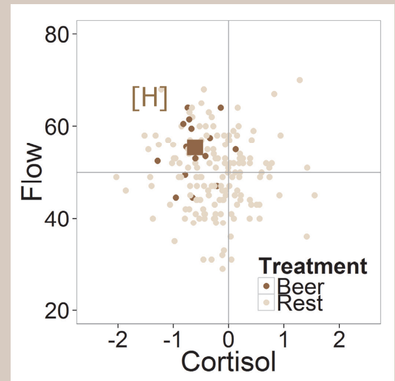
- 2x team-based negotiation educational games (topic: the European Union); computer and non-computer based variants (EU-comp; EU-no-comp) [high flow, high ST/UC]
- an educational workshop with intense discussions (topic: the EU; EU-class) [low flow, high ST/UC]
- an interactive educational computer-based simulation (topic: beer brewing) [high flow, low ST/UC]
- a car accident simulation, part of a first-aid training course; two participant groups: Aid-actors [high flow, low ST/UC], Aid-participants [high-flow, high ST/UC]
- an entertaining life action role-playing (Larp) [high flow, ST/UC diverse]

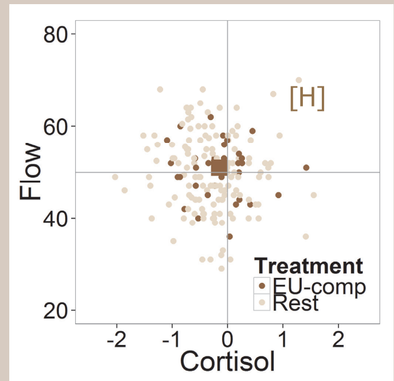
We measured and administered:

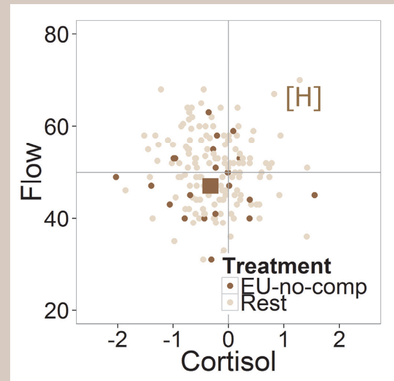
- Pre- and post-exposure salivary cortisol (morning and around noon)
- PANAS (Watson et al., 1988)
- Flow Short Scale (Rheinberg et al., 2003)
- the short version of SIAS (Kupper & Denollet, 2012; for the three EU-* treatments)
- the Revised Competitiveness Index with contentiousness and enjoyment of competition dimensions (Harris & Houston, 2010; for the three EU-* treatments)

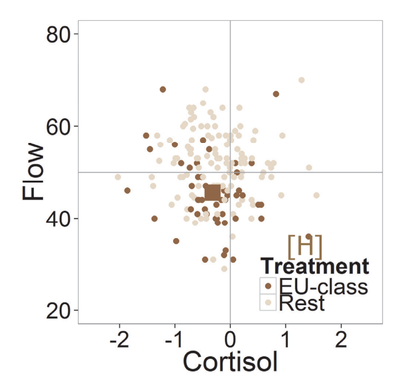












Results

The results show significant differences between flow levels, $F(6, 181) = 9.6$, $p < .001$, and cortisol levels, $F(6, 164) = 3.43$, $p < .01$, for participants assigned to different treatments. Cortisol levels were highest for participants undergoing a high ST/UC treatment and/or a life action role playing. We found no general cortisol-flow relationship, but ST/UC interventions elicited higher cortisol responses in individuals who were not contentious and also in males (but not females) with higher trait social interaction anxiety, with higher negative affective state, and with lower flow state (approaching significance).

Conclusions

Cortisol values were influenced by gender, in combination with some of the participants' personal characteristics (in our case: social interaction anxiety and contentiousness) and treatment characteristics (social-evaluative threat, uncontrollability), rather than by the learners' flow levels. Team-based serious games with ST components may have adverse effects on learners, particularly males, with high social interaction anxiety. This outcome extends past research on the flow-cortisol relationship and corroborates earlier studies on cortisol release in ST interventions.

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