



## Original Articles

# The grammar of anger: Mapping the computational architecture of a recalibrational emotion



Aaron Sell<sup>a,b,\*</sup>, Daniel Sznycer<sup>a,c,i</sup>, Laith Al-Shawaf<sup>d,e</sup>, Julian Lim<sup>a</sup>, Andre Krauss<sup>f</sup>, Aneta Feldman<sup>g</sup>, Ruxandra Rascanu<sup>g</sup>, Lawrence Sugiyama<sup>h</sup>, Leda Cosmides<sup>a</sup>, John Tooby<sup>a</sup>

<sup>a</sup> Center for Evolutionary Psychology, University of California, Santa Barbara, CA 93106, USA

<sup>b</sup> School of Criminology and Criminal Justice, Griffith University, Mount Gravatt, QLD 4111, Australia

<sup>c</sup> Department of Psychology, Arizona State University, Tempe, AZ 85287-1104, USA

<sup>d</sup> Department of Psychology and Interdisciplinary Neuroscience Program, Bilkent University, 06800 Bilkent, Ankara, Turkey

<sup>e</sup> College of Life Sciences, Institute for Advanced Study, Berlin, Germany

<sup>f</sup> Center for the Study of Entertainment Media Influences, Arad 310130, Romania

<sup>g</sup> Department of Psychology, The University of Bucharest, București 030018, Romania

<sup>h</sup> Department of Anthropology and Institute of Cognitive and Decision Sciences, University of Oregon, Eugene, OR 97403, USA

<sup>i</sup> Université de Montréal, Département de Psychologie, Pavillon Marie-Victorin, C.P. 6128, succursale Centre-ville, Montréal, QC H3C 3J7, Canada

## ARTICLE INFO

## Article history:

Received 14 November 2016

Revised 30 May 2017

Accepted 3 June 2017

## Keywords:

Anger

Evolutionary psychology

Arguments

Welfare tradeoff ratio

Recalibrational theory

## ABSTRACT

According to the recalibrational theory of anger, anger is a computationally complex cognitive system that evolved to bargain for better treatment. Anger coordinates facial expressions, vocal changes, verbal arguments, the withholding of benefits, the deployment of aggression, and a suite of other cognitive and physiological variables in the service of leveraging bargaining position into better outcomes. The prototypical trigger of anger is an indication that the offender places too little weight on the angry individual's welfare when making decisions, i.e. the offender has too low a *welfare tradeoff ratio* (WTR) toward the angry individual. Twenty-three experiments in six cultures, including a group of foragers in the Ecuadorian Amazon, tested six predictions about the computational structure of anger derived from the recalibrational theory. Subjects judged that anger would intensify when: (i) the cost was large, (ii) the benefit the offender received from imposing the cost was small, or (iii) the offender imposed the cost despite knowing that the angered individual was the person to be harmed. Additionally, anger-based arguments conformed to a conceptual grammar of anger, such that offenders were inclined to argue that they held a high WTR toward the victim, e.g., “the cost I imposed on you was small”, “the benefit I gained was large”, or “I didn't know it was you I was harming.” These results replicated across all six tested cultures: the US, Australia, Turkey, Romania, India, and Shuar hunter-horticulturalists in Ecuador. Results contradict key predictions about anger based on equity theory and social constructivism.

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## 1. Introduction

Anger is a complex neural system that orchestrates behavior, physiology, facial and vocal expressions, perceptual changes, motivational priorities, memory, attention, and energy regulation in response to interpretations of social events (Fessler, 2010; Lazarus, 1991; Potegal, Stemmler, & Spielberger, 2010; Sell, 2011a; Smith & Ellsworth, 1985; Tooby & Cosmides, 1990). This system is instantiated in a network of brain regions (Kragel & LaBar, 2016), shows early ontogenetic development (e.g. the anger

face is functional at six months; Stenberg, Campos, & Emde, 1983), and demonstrates cross-cultural uniformity in basic design (Alonso-Arbiol et al., 2011; Ekman, 1973; Wallbott & Scherer, 1986). Furthermore, some features of anger are known to develop without exposure to the information that would be required to learn them through more general purpose systems, e.g., congenitally blind children produce normal anger facial expressions (Galati, Sini, Schmidt, & Tinti, 2003). This evidence fits with the generally accepted conclusion that anger is – at least in part – a species-typical system designed by natural selection (Potegal et al., 2010; though see Barrett, 2017).

If anger did indeed evolve by natural selection, then identifying the function of anger (i.e., the way in which it increased the fitness of our ancestors) should predict and explain the

\* Corresponding author at: School of Criminology and Criminal Justice, Griffith University, Mount Gravatt Campus, Mount Gravatt, QLD 4111, Australia.

E-mail address: [a.sell@griffith.edu.au](mailto:a.sell@griffith.edu.au) (A. Sell).

information-processing structure of anger, just as understanding the function of mate choice has allowed evolutionary psychologists to explain the complexly organized nature of attractiveness (e.g. Sugiyama, 2005).

The recalibrational theory holds that anger evolved to bargain for better treatment. This theory was first derived from basic principles of evolutionary biology, including the theory of bargaining and game theory (Sell, 2006; Sell, Tooby, & Cosmides, 2009), which argue that organisms have two fundamental tools to bargain for better outcomes: conditional aggression (threat), or conditional cooperation (contingent benefit delivery). With these, organisms can incentivize the other party to shift their behavior in a way that is favorable to the bargainer. This underlying theoretical approach to bargaining was combined with a leading evolutionary approach to emotions, which holds that the neural basis of any specific emotion is conceptualized as a superordinate control program that evolved to orchestrate the diverse mechanisms in the organism into a best-bet configuration to respond to an evolutionarily recurrent adaptive problem (Sell et al., 2009; Tooby & Cosmides, 1990, 2008).

The function identified by the recalibrational theory of anger is to resolve conflicts of interest more in favor of the angry individual. That is, the anger system was designed by natural selection to orchestrate the subcomponents of the organism's architecture (e.g. physiology, behavior, cognitive structures) in order to leverage its bargaining advantages over another organism and incentivize that organism to place more weight on the angry individual's welfare. Informally, the signal is (in cooperative relationships) *do more of what I want or I will do less of what you want*, and (in noncooperative relationships) *do more of what I want or I will inflict costs on you*.

Elsewhere we have more fully derived this adaptationist theory of the design of anger from basic principles (Sell, 2006; Sell et al., 2009; Tooby & Cosmides, 2008). In this paper, we add to this by examining how some of the major features of anger support the hypothesis that they evolved in the service of bargaining for better treatment (Sections 1.1 and 1.2). We then use the theory to generate six hypotheses about the triggers of anger (Section 1.4), and experimentally test them with vignettes in six cultures. Predictions #1 through #3 relate to the computational structure of the triggers of anger; predictions #4 through #6 relate to how people argue over an incident of anger.

### 1.1. The recalibrational theory as a guide to reverse engineering anger

According to the recalibrational theory of anger (Sell, 2006, 2011a, 2011b; Sell et al., 2009; Tooby, Cosmides, Sell, Lieberman, & Sznycer, 2008) anger is designed to bargain for better treatment. Thus, anger has features designed to gather the attention of the target and interact with that target in ways that – if successful – incline the target to behave in a way that more highly values the angry person's interests in the present or future. Indeed, the major features of anger are all consistent with this function (see also Sell, 2011a, 2011b; Sell et al., 2009):

#### 1.1.1. The major triggers of anger are cues of the target's motivational state

The most common triggers of anger are cues about what might loosely be identified as the intentions and beliefs of the target of anger; and experiments reveal that it is these intentions and beliefs that trigger anger more than any particular tangible harm (Averill, 1982; Epstein & Taylor, 1967; Ohbuchi & Kambara, 1985; Smith & Ellsworth, 1985). Furthermore, anger-based aggression typically results from the revelation that the target of anger does not “respect” the angry individual rather than any specific harm

done (Daly & Wilson, 1988; Felson, 1982). (Here, we interpret “respect” to mean the weight placed on the actor's welfare.) Finally, anger focuses attention on cues of the target's mental state which is often probed directly, i.e. the targets of anger are frequently interrogated about why they did what they did (Averill, 1982). In sum, anger is activated by cues of what the target thinks of the angry person and the importance of their affairs. These are indispensable design features we would expect in a system designed to recalibrate a target's propensity to place weight on the actor's interests.

#### 1.1.2. Anger is designed to gather the target's attention

An adaptation designed to recalibrate a target's mind must seek out that target. Therefore, anger – particularly in the early stages of its deployment – motivates approach toward the target of anger (an anomaly among negatively valenced emotions; Carver & Harmon-Jones, 2009). Furthermore, anger signals its onset to the target with a highly recognizable (Fox et al., 2000; Öhman, Lundqvist, & Esteves, 2001) and universal facial expression (Ekman, 1973). According to the recalibrational theory, the anger expression is the signal that the target's action expresses too little weight—that is, is an unacceptably low “bid”, and that this bid is rejected. Finally, during aggressive bargaining, the anger face triggers muscles in the face that enhance cues of physical strength and fighting ability (Sell, Cosmides, & Tooby, 2014) in a way analogous to non-human animals that bare their fangs or inflate their lungs as threats to aggression.

#### 1.1.3. The most common response to anger is rapid information exchange

Once anger has motivated the actor to gather the attention of the target, it enacts strategies designed to interface with and recalibrate cognitive structures in the target (Averill, 1982, 1983). This is usually done by rapid, focused communication with the target, e.g., an argument or a display. During these arguments, anger modifies the voice in ways that generally increase the speed and salience of speech (Banse & Scherer, 1996), and signal through increasing volume and roughening of the voice the activation of the sympathetic pathways involved in preparation for combat. This communication should be relevant to the bargaining dynamics between the two individuals, based on the ability to confer benefits, or to inflict harms (aggression). The angry individual should emphasize that the offense placed too little weight on their welfare, given the benefit to the offender. Other relevant features are the importance of the benefits that the angry individual has conferred previously, or could withhold. If the two are not in a cooperative relationship, then the angry individual could emphasize his ability to inflict costs (demonstrate formidability) by e.g., pounding a table, shaking a fist, breaking something, or striking the target (see Section 4).

#### 1.1.4. Anger-based aggression is largely communicative

Although anger usually does not lead to aggression (Averill, 1983), when it does, the design of this aggression is communicative in nature; in other words, the aggression does not efficiently injure or kill the target, but instead demonstrates fighting ability, determination, or the willingness to take the interaction into the realm of physical harm. An incident of anger-based aggression typically starts with aggressive signaling, will dissipate if the target retreats or submits, and escalates from less dangerous to more dangerous aggressive acts only if the target retaliates or fails to conciliate (Felson, 1982). Thus, anger-based aggression typically appears designed to recalibrate the target rather than incapacitate or kill.

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