

## Secondary Publication



Troiano, Enrica; Oberländer, Laura; Klinger, Roman

### Dimensional Modeling of Emotions in Text with Appraisal Theories : Corpus Creation, Annotation Reliability, and Prediction

Date of secondary publication: 18.07.2024

Version of Record (Published Version), Article

Persistent identifier: urn:nbn:de:bvb:473-irb-965225

#### Primary publication

Troiano, Enrica; Oberländer, Laura; Klinger, Roman (2023): „Dimensional Modeling of Emotions in Text with Appraisal Theories : Corpus Creation, Annotation Reliability, and Prediction“. In: Computational linguistics, Vol. 49, Nr. 1, pp. 1-72, Cambridge, MA: MIT Press, doi: 10.1162/coli\_a\_00461.

#### Legal Notice

This work is protected by copyright and/or the indication of a licence. You are free to use this work in any way permitted by the copyright and/or the licence that applies to your usage. For other uses, you must obtain permission from the rights-holders.

This document is made available under a Creative Commons license.



The license information is available online:

<https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode>

# Dimensional Modeling of Emotions in Text with Appraisal Theories: Corpus Creation, Annotation Reliability, and Prediction

Enrica Troiano\*

Institut für Maschinelle  
Sprachverarbeitung  
University of Stuttgart  
enrica.troiano@ims.uni-  
stuttgart.de

Laura Oberländer\*

Institut für Maschinelle  
Sprachverarbeitung  
University of Stuttgart  
laura.oberlaender@ims.uni-  
stuttgart.de

Roman Klinger\*

Institut für Maschinelle  
Sprachverarbeitung  
University of Stuttgart  
roman.klinger@ims.uni-stuttgart.de

*The most prominent tasks in emotion analysis are to assign emotions to texts and to understand how emotions manifest in language. An important observation for natural language processing is that emotions can be communicated implicitly by referring to events alone, appealing to an empathetic, intersubjective understanding of events, even without explicitly mentioning an emotion name. In psychology, the class of emotion theories known as appraisal theories aims at explaining the link between events and emotions. Appraisals can be formalized as variables that measure a cognitive evaluation by people living through an event that they consider relevant. They include the assessment if an event is novel, if the person considers themselves to be responsible, if it is in line with their own goals, and so forth. Such appraisals explain which emotions are developed based on an event, for example, that a novel situation can induce surprise or one with uncertain consequences could evoke fear. We analyze the suitability of appraisal*

---

\* All authors contributed equally.

Action Editor: Saif M. Mohammad. Submission received: 10 June 2022; revised version received: 25 July 2022; accepted for publication: 24 August 2022.

<https://doi.org/10.1162/coli.a.00461>

*theories for emotion analysis in text with the goal of understanding if appraisal concepts can reliably be reconstructed by annotators, if they can be predicted by text classifiers, and if appraisal concepts help to identify emotion categories. To achieve that, we compile a corpus by asking people to textually describe events that triggered particular emotions and to disclose their appraisals. Then, we ask readers to reconstruct emotions and appraisals from the text. This set-up allows us to measure if emotions and appraisals can be recovered purely from text and provides a human baseline to judge a model's performance measures. Our comparison of text classification methods to human annotators shows that both can reliably detect emotions and appraisals with similar performance. Therefore, appraisals constitute an alternative computational emotion analysis paradigm and further improve the categorization of emotions in text with joint models.*

## 1. Introduction

Voices that have had a say about the affective life of humans have been raised from multiple disciplines. Over the centuries, philosophers, neuroscientists, and cognitive and computational researchers have been drawn to the study of passions, feelings, and sentiment (Scarantino 2016; Adolphs 2017; Oatley and Johnson-Laird 2014; Karg et al. 2013). Among such affective phenomena, emotions stand out. For one thing, they are many: While sentiment can be described with a handful of categories (e.g., neutral, negative, positive), it takes a varied vocabulary to distinguish the mental state that accompanies a cheerful laughter from that enticing a desperate cry, one felt before a danger from one arising with an unexpected discovery (e.g., joy, sadness, fear, surprise). These seemingly understandable experiences are also complex to define. Psychologists diverge on the formal description of emotion—both of emotion as a coherent whole, and of emotions as many differentiated facts. What has ultimately been agreed upon is that emotions can be studied systematically (cf. Dixon 2012, p. 338), and that people use specific “diagnostic features” to recognize them (Scarantino 2016). They are the presence of a stimulus event, an assessment of the event based on the concerns, goals, and beliefs of its experiencer and some concomitant reactions (e.g., the cry, the laughter).

Like other aspects of affect, emotions emerge from language (Wierzbicka 1994); as such, they are of interest for natural language processing (NLP) and computational linguistics (Sailunaz et al. 2018). The cardinal goal of computational emotion analysis is to recognize the emotions that texts elicit in the readers, or those that pushed the writers to produce an utterance in the first place. Irrespective of their specific subtask, classification studies start from the selection of a theory from psychology, which establishes the ground rules of their object of focus. Commonly used frameworks are the Darwinistic perspectives of Ekman (1992) and Plutchik (2001). They depict emotions in terms of an evolutionary adaptation that manifests in observable behaviors, with a small nucleus of experiences that intersect all cultures. *Discrete* states like anger, fear, or joy are deemed universal, and thus constitute the phenomena to be looked for in text. Besides basic emotions, much research has leveraged a *dimensional* theory of affect, namely, the circumplex model by Posner, Russell, and Peterson (2005). It consists of a vector space defined by the dimensions of valence (how positive the emoter feels) and arousal (how activated), which enables researchers to represent discrete states in a continuous space, or to have computational models exploit continuous relations between crisp concepts, as an alternative to predefined emotion classes. Further, some works acknowledge the central role of events in the taking place of an emotion, and the status of emotions as events themselves. These works constitute a special case of semantic role labeling, primarily aimed at detecting precise aspects of emotional episodes that are mentioned

in text, like emotion stimuli (Bostan, Kim, and Klinger 2020; Kim and Klinger 2018; Mohammad, Zhu, and Martin 2014; Xia and Ding 2019).

Studies assigning texts to categorical emotion labels (Mohammad 2012; Klinger et al. 2018, i.a.), and to subcomponents of affect (Preotiuc-Pietro et al. 2016; Buechel and Hahn 2017a, i.a.) or of events, have a pragmatic relationship to the chosen psychological models. They use theoretical insights about which emotions should be considered (e.g., anger, sadness, fear) and how these can be described (e.g., by means of discrete labels), but they do not account for what emotions are. In other words, they disregard a crucial diagnostic feature of emotions, namely, that emotions are reactions to events that are *evaluated* by people. The ability of evaluating an environment allows humans to figure out its properties (if it is threatening, harmless, requires an action, etc.), which in turn determine if and how they react emotionally. Therefore, to overlook evaluations is to dismiss a primary emotion resource, and, most importantly for NLP, a tool to extrapolate affective meanings from text.

The relevance of evaluations in text becomes clear considering mentions of factual circumstances. Writers often omit their emotional reactions, and they only communicate the eliciting event. In such cases, an emotion emerges if the readers carry out an interpretation, engaging their knowledge about event participants, typical responses, possible outcomes, and world relations. For instance, it is thanks to an (extra-linguistic) assessment that texts like “the tyrant passed away” and “my dog passed away” can be associated with an emotion meaning, and specifically, with different meanings. The two sentences describe semantically similar situations (i.e., death), but their subjects change the comprehension of how the writer was affected in either case. Accordingly, the first text can be charged with relief while the other likely expresses sadness.

While not directly addressing texts, psychology has produced abundant literature on the relationship between emotions and evaluations. Appraisal theories are an entire class of frameworks that has discussed emotions in terms of the cognitive *appraisal* of an event, together with the subjective feelings, action tendencies, physiological reactions, and bodily and vocal expressions that the event can trigger (Staller, Petta et al. 2001; Gratch et al. 2009). All of these factors are relevant for computational linguistics because they realize in language (De Bruyne, Clercq, and Hoste 2021; Casel, Heindl, and Klinger 2021)—for example, writers can describe their verbal (“oh, wow”) or motor response to a situation (“I felt paralyzed!”) in order to convey an emotion. However, the appraisal component plays a special part. Appraisal theorists elaborate extensively and variously on its contribution in an emotion experience. In the OCC view, which is a specific appraisal-based approach named after its authors Ortony, Clore, and Collins (Clore and Ortony 2013), an appraisal is a sequence of binary evaluations that concern events, objects, and actions (i.e., how good or bad, pleasant or unpleasant they are, whether they match social and personal moral standards). By contrast, scientists like Smith and Ellsworth (1985) and Scherer (2005), who organize the emotion components into a holistic process, qualify appraisals with more detailed criteria, as dimensions along which people assess events: “is it pleasant?”, “did I see that coming?”, “do I have control over its development?”, “do I expect an outcome in line with my goals?”. Different combinations of these dimensions correspond to different emotions. Intuitively, unpleasantness and the hampering of one’s goals could elicit anger; unpleasantness, unexpectedness, and a low degree of control could induce fear.

The latter approach has found its way into computational research, mainly to make robot agents aware of social processes (Kim and Kwon 2010; Breazeal, Dautenhahn, and Kanda 2016). To us, it represents a promising avenue also for emotion analysis in text. The evaluation criteria of Smith and Ellsworth (1985) and Scherer (2005) can be

leveraged to explain why linguistically similar texts convey opposite emotions (e.g., “the tyrant passed away” and “my dog passed away” are assigned different properties, like pleasantness and alignment with one’s goals). Hence, appraisals<sup>1</sup> can bring valuable information for annotation studies. Collecting these types of judgments might reveal why annotators picked a certain emotion label (e.g., they appraised the described event differently in the first place), and might eventually disclose underlying patterns in their disagreement. As for emotion classification, the fine-grained appraisal dimensions discussed above provide a more expressive tool than basic-, dimensional-, and OCC-based models. Endowed with such representations, systems might ultimately turn more human-like and theoretically grounded: Because appraisal dimensions are a finite set of features, they can formalize differences between events, possibly promoting better classification performances.

In this work, we put these ideas under scrutiny. We aim at understanding if appraisal theories (specifically, the component process model) can be used in the field of emotion analysis and advance it. Much in the way in which past work has predicted the emotion of text writers via readers and computational models, we investigate if the evaluations/appraisals carried out by event experiencers can be reconstructed, given the texts in which they mention such events, by humans and by automatic classifiers.

Evaluations of emotion-inducing events have actually been leveraged in NLP, but only by a handful of studies. Of this type are Shaikh, Prendinger, and Ishizuka (2009), Balahur, Hermida, and Montoyo (2011, 2012), Hofmann et al. (2020), Hofmann, Troiano, and Klinger (2021), and Troiano et al. (2022). These works proposed approaches to make emotion categorization decisions motivated by appraisal theories, but they did not analyze the suitability of these theories for NLP. Understanding the limits and possibilities of an appraisal-oriented approach to emotion analysis indeed poses a major challenge: There is no available corpus that contains annotations of our concern (i.e., provided by first-hand event experiencers). A useful and public resource with a machine-learning appropriate size exists (i.e., ISEAR by Scherer and Wallbott [1997]), but its texts are impractical for us, because they were produced by a combination of native and non-native speakers, who only consisted of college students. ISEAR was not compiled for purposes of text analysis, but to investigate the relation between appraisals and emotions; and no validation of the annotations has been performed in the same experimental environment. To solve these issues, we crowdsource a corpus of emotion-inducing event descriptions produced by English native speakers, annotated with emotions, event evaluations (using 21 appraisals), stable properties of the texts’ authors (e.g., demographics, personality traits), and contingent information concerning their state at the moment of taking our study (i.e., their current emotion). The resulting collection, to which we refer as crowd-enVENT,<sup>2</sup> encompasses 6,600 instances. Part of it is subsequently annotated by external crowdworkers, tasked to read the descriptions and to infer how the authors originally appraised the events in question.

Dealing with texts that convey subjective experiences, our approach also relates to some research lines in sentiment analysis aimed at recognizing “people’s opinions, sentiments, evaluations, appraisals, attitudes, [...] towards entities such as products, [...] issues, events, topics, and their attributes” (Liu 2012). Rich literature can be found on implicit expressions of polarized evaluations, but it targets specific types of opinions,

---

1 In this work, we use “appraisals” and “appraisal dimensions” interchangeably.

2 This name indicates that it has been crowdsourced and is in English. This is in contrast to our corpus x-enVENT (Troiano et al. 2022), which has been annotated by trained experts with similar variables. It constitutes a preparatory study to crowd-enVENT.

for example, those expressed in business news (Jacobs and Hoste 2021, 2022) and in meeting discussions (Wilson 2008). Much of such work has the goal of understanding if texts contain evaluations (Toprak, Jakob, and Gurevych 2010), or how their polarity can be traced back to specific linguistic cues, like negations and diminishers (Musat and Trausan-Matu 2010), indirectly valenced noun phrases (Zhang and Liu 2011b), and their combination with verbs and quantifiers (Zhang and Liu 2011a). By contrast, we do not restrict ourselves to any type of event; most importantly, we relate evaluations to people's background knowledge with the theoretically motivated taxonomy of 21 appraisals, to make the type of evaluations behind an emotion experience and an emotion judgment transparent.

Our study revolves around four research questions. (RQ1) Is there enough information in a text for humans and classifiers to predict appraisals? (RQ2) How do appraisal judgments relate to textual properties? (RQ3) Can an appraisal or an emotion be reliably inferred only if the original event experiencer and the text annotator share particular properties? (RQ4) Do appraisals practically enhance emotion prediction? By leveraging crowd-enVENT,<sup>3</sup> we investigate if (and to what extent) people's appraisals can be interpreted from texts, and if models' predictions are more similar to those who lived the experience first-hand, or resemble more the external judges' (RQ1). To gain better insight, we analyze the data and classification models qualitatively (RQ2). Further, we verify if the sharing of stable/contingent properties between the texts' generators and validators, including demographics, personality traits, and cultural background, affects the similarity of their judgments (RQ3). Lastly, narrowing the focus on emotion classification, we evaluate if and in what case this task benefits from appraisal knowledge. More specifically, we compare human performance to that of computational models that predict emotions and appraisals, separately or jointly (RQ4).

In sum, we present a twofold contribution to the field. First, we propose appraisal-based emotion analysis with a rich set of variables that has never been investigated before in NLP: We cast a novel paradigm that complements models of basic emotions and dimensional models of affect, showing that appraisal dimensions can be useful to infer some mental states from text. Appraisal information indeed proves a valuable contribution to emotion classifiers and constitutes a prediction target itself. It comes with the advantage of being interpretable, as are basic emotion names, and dimensional, as is affect in dimensional models that enable measuring similarities between emotions. Second, we introduce a corpus of event descriptions richly annotated with appraisals from the perspectives of both writers and readers that we compare. Besides emotion classification in general, and for the track of investigation interested in differences between annotation perspectives, our resource can be a benchmark for research focused on human evaluations of real-life circumstances. Lastly, for psychology, our study represents a computational counterpart of previous work, which encompasses a large set of appraisal variables and reveals how well they transfer to the domain of language.

This article is structured as follows. In Section 2, we review research on emotions from psychology and NLP to draw a parallel between the two. Section 3 provides an overview of our study and introduces essential concepts for our study design. It further illustrates how previous work has (or has not) addressed them. It presents the problem of emotion recognition in psychology, which is mostly based on facial interpretations, and from the NLP side it discusses measures of annotation agreement. Next, we

<sup>3</sup> Supplementary material, including data and code, are available at <https://www.ims.uni-stuttgart.de/data/appraisalemotion>.

explain our data collection procedure (Section 4) and analyze it (Section 5). The resulting insights constitute a motivation as well as a baseline for the modeling experiments, described in Section 6. The article concludes with a discussion of the limitations of our approach, some possible solutions, interesting ventures for future work, and ethical points of concern.

## 2. Emotion Theories and Their Application in Natural Language Processing

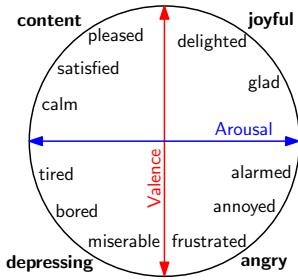
Emotions represent an interdisciplinary challenge. Explaining what they are and how they arise is an attempt that can take substantially different paths, depending on the considered types of episodes (anger, joy, etc.), the underlying mechanisms that one looks at, and their meaning in language. The insights provided by different directions in the literature share some commonalities nevertheless. This suggests that the corresponding approaches in computational emotion analysis are also not in conflict, but rather complement each other. In the following, we give an overview of previous work both from psychology and NLP to contextualize the appraisal theories used in this study. We specifically follow the organization of Scarantino (2016, p. 8), who divides psychological currents on the topic into a *feeling tradition*, a *motivational tradition*, and an *evaluative tradition*.

### 2.1 Feeling and Affect

In the **feeling tradition**, emotions are not seen as innate universals. They are learned constructs whose development relies on culture and contingent situations. *Constructionist* approaches are one instance of this tradition (James 1894). Pioneered by William James, they theorize that “bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion.” James claims that “we feel sorry because we cry, angry because we strike, afraid because we tremble, and not that we cry, strike, or tremble, because we are sorry, angry, or fearful” (reported from Myers 1969).

The perception-to-emotion view has sparked heated debates, with the counter-argument that humans’ emotional processes do not unfold in such a strict sequential order. Contemporary constructionists address this criticism by explaining that emotions are shaped dynamically. The “brain prepares multiple competing simulations that answer the question, what is this new sensory input most similar to?” (Feldman Barrett 2017, p. 7). This similarity calculation is based on perception, energy costs, and rewards for the body. Therefore, emotions are constructed thanks to the engagement of resources that are not specific to an emotion module, similar to the building blocks of an algorithm that could be arranged to create alternative instructions (Feldman Barrett 2017, i.a.). One of the basic pieces out of which emotions are constructed is **affect**, or “the general sense of feeling that you experience throughout each day [...] with two features. The first is how pleasant or unpleasant you feel, which scientists call valence. [...] The second feature of affect is how calm or agitated you feel, which is called arousal” (Feldman Barrett 2018, p. 72). Hence, the simulation process links affect to a complex emotion perception.

Other constructionist theorists relate emotions with affect as well. Posner, Russell, and Peterson (2005), for instance, assign emotions to specific positions within the circumplex model depicted in Figure 1, a continuous affective space that is defined by the dimensions of valence and arousal. Bradley and Lang (1994) extend this model to a valence-arousal-dominance (VAD) one. There, emotions vary from one another



**Figure 1**  
The circumplex model of emotions, a dimensional emotion model.

in regard to the three VAD factors, with dominance representing the power that an experiencer perceives to have in a given situation.

A wave of studies based on affect also exists in NLP. It has been dedicated to predicting the continuous values of valence, arousal, and dominance, defining a regression task that is commonly solved with deep-learning systems, sometimes informed by lexical resources (Wei, Wu, and Lin 2011; Buechel and Hahn 2016; Wu et al. 2019; Cheng et al. 2021, i.a.). Dimensional models of emotion have indeed many advantages from a computational perspective. They formalize relations between emotions in a computationally tractable manner, for example, models learn that texts expressing sadness and those conveying anger are both characterized by low valence. This means that in an affect recognition task, machine learning systems bypass the decision of picking one out of various states that are similar to one another in respect to some dimensions, and that could equally hold for a given text. In fact, at modeling time, researchers are not compelled to be provided with categorical emotion information at all. Systems only need to learn relations between valence and arousal, and in the event the final goal is to classify texts with discrete emotions, the VA(D)-to-emotion mapping can be left as a step outside the machine learning task.

Still, there have been attempts to integrate the dimensional model with discrete emotions. Park et al. (2021) propose a framework to learn a joint model that predicts fine-grained emotion categories together with continuous values of VAD. They do so using a pretrained transformer-based model (namely, RoBERTa, Liu et al. 2019), fine-tuned with earth movers distance (Rubner, Tomasi, and Guibas 2000) as a loss function to perform classification. Related approaches learn multiple emotion models at once, showing that a multi-task learning of discrete categories and VAD scores can benefit both subtasks (Akhtar et al. 2019; Mukherjee et al. 2021). Particularly interesting for our work is the study by Buechel, Modersohn, and Hahn (2021). They define a unified model for a shared latent representation of emotions, which is independent from the language of the text, the used emotion model, and the corresponding emotion labels. In a similar vein, we aim at integrating appraisal theories with discrete emotion experiences, seeing the dimensions coming from the former as a latent representation of the latter.

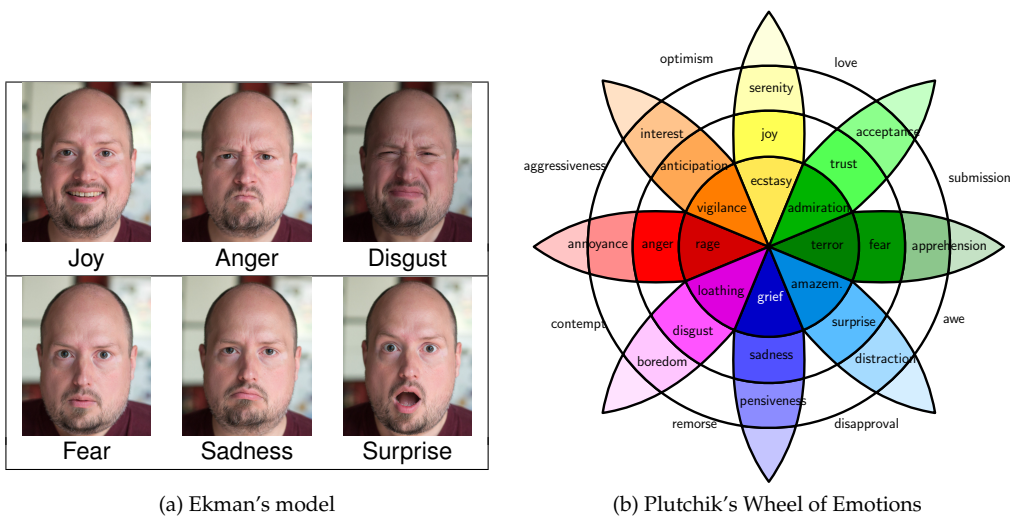
Many efforts in NLP focus on (automatically) creating lexicons. Terms are assigned VAD scores based on their semantic similarity to other words, for which manual annotations are provided (Köper, Kim, and Klinger 2017; Buechel, Hellrich, and Hahn 2016). To date, lexicons are available for both English (Bradley and Lang 1999; Warriner, Kuperman, and Brysbaert 2013; Mohammad 2018) and other languages (e.g., Buechel, Rücker, and Hahn [2020] created lexicons for 91 languages, including Korean, Slovak,

Icelandic, Hindi), and so are corpora annotated at the sentence or paragraph level with (at least a subset of) VAD information—among others are Preotiuc-Pietro et al. (2016), Buechel and Hahn (2017b), and Buechel and Hahn (2017a) for English, Yu et al. (2016) for Mandarin and Mohammad et al. (2018) for Spanish and Arabic. Using corpora, research has investigated how the valence and arousal that emerge from text co-vary with some attributes of the writers, such as age and gender (Preotiuc-Pietro et al. 2016). Moreover, it has revealed that annotators who infer emotions from text by attempting to assume the writer’s perspective achieve higher inter-annotator agreement than those who report their personal reactions (Buechel and Hahn 2017b). The finding that the quality of an annotation effort can change depending on the perspective of text understanding will turn out crucial for the design decision of our work.

## 2.2 Motivation and Basic Emotions

The **motivational tradition** includes “theories of basic emotion,” of which Ekman (1992) is a prominent representative. Ekman’s research is characterized by a Darwinistic approach: Aimed at measuring observable phenomena, it qualifies as basic emotions those found among other primates, those that have precise universal signals, a quick onset, a brief duration, an unbidden occurrence, coherence among instances of the same emotion, distinctive physiology, and, importantly for our work, distinctive universals in antecedent events and an automatic appraisal. The idea that emotions can be distinguished by their physiological manifestation pushed research in psychology to investigate and code the movements of facial muscles (Clark et al. 2020), with specific configurations corresponding to specific emotions. Hence, the basic emotions of fear, anger, joy, sadness, disgust, and surprise are commonly illustrated with depictions similar to Figure 2a.

The definition of what constitutes a basic emotion is different in the Wheel of Emotions (Plutchik 2001) illustrated in Figure 2b. As Scarantino (2016) puts it, based on Plutchik (1970), an emotion is “a patterned bodily reaction of either protection,



**Figure 2**  
Visualizations of basic emotion models.

destruction, reproduction, deprivation, incorporation, rejection, exploration or orientation” (p. 12). According to Plutchik, each reaction function corresponds to a primary emotion, namely, fear, anger, joy, sadness, acceptance, disgust, anticipation, and surprise. Primary emotions can be composed to obtain others, like colors, and they are characterized by their intensity gradation. The wheel includes indeed a dimension of intensity (in/outside), similar to the variable of arousal (e.g., higher intensity–darker color: ecstasy; lower intensity–fairer gradation: serenity). In this sense, Plutchik links discrete emotion theories with dimensional ones.

Theories of basic emotions constitute an (often tacit) argument used in NLP: Different emotions can be clearly recognized not only via faces but also when the communication channel is text. This is the main notion that computational studies of emotions borrow from basic emotion theories in psychology, although the latter offers a much more varied picture. For example, Ekman also describes non-basic emotions as “emotional plots,” moods, and affective personality traits. Further, he characterizes (basic and non-basic emotions) as “programs,” which lead to a sequence of changes, when activated. These changes include action tendencies, alterations in one’s face, voice, autonomic nervous system, and body; plus, they trigger the retrieval of memories and expectations (cf. constructionist theories), which guide how we interpret what is happening within and around us. If emotions denote categorical states, their perception happens thanks to the contribution of multiple components—an idea that remains overlooked in NLP.

Early attempts to link language and emotions focus on the construction of lexicons. An example is the Linguistic Inquiry and Word Count (LIWC), aimed at providing a list of words that are reliably associated with psychological concepts across domains and application scenarios (Pennebaker, Francis, and Booth 2001). Both this lexicon and the associated text processing software are well-rooted in psychological concepts, with emotions being only a subset of the labels. Instead, the development of WordNet Affect (Strapparava and Valitutti 2004) has been prominently conducted for computational linguistics. It has enriched the established resource of WordNet with emotion categories through a semi-automatic procedure. Taking a more empirical perspective on data creation, the NRC Emotion Lexicon has been crowdsourced, resulting in a more comprehensive dictionary (Mohammad and Turney 2012).

For classification problems, in which pieces of texts are assigned to one or many discrete emotion labels, lexicons are handy. They provide transparent access to the emotion of words, in order to analyze the emotion of the texts that such words compose. At the same time, statistical approaches and deep learning methods can solve the task without relying on dictionaries. Models for emotion prediction are by and large standard text classification approaches, either feature-based methods with linear classifiers or transfer learning methods based on pretrained transformers. Various shared tasks provide a good overview on the topic (Strapparava and Mihalcea 2007; Klinger et al. 2018; Mohammad et al. 2018).

A crucial requirement for these types of automatic systems is the availability of appropriately sized and representative data: In emotion analysis, models trained on one domain typically strongly underperform in another (Bostan and Klinger 2018). Ready-to-use corpora nowadays span many domains, including stories (Alm, Roth, and Sproat 2005), news headlines (Strapparava and Mihalcea 2007), songs lyrics (Mihalcea and Strapparava 2012), tweets (Mohammad 2012), conversations (Li et al. 2017; Poria et al. 2019), and Reddit posts (Demszky et al. 2020). Many resources limit their labels to the most frequent or most fitting emotion categories in the respective domain. Only a handful uses more than the eight emotions proposed by Plutchik. Exceptions are

the corpora by Abdul-Mageed and Ungar (2017) and Demszky et al. (2020), who built two large resources for emotion detection, respectively containing tweets with all 24 emotions present in Plutchik's wheel, and Reddit comments associated with 27 emotion categories. We refer the reader to Bostan and Klinger (2018) for a more complete overview of emotion corpora.

### 2.3 Evaluation and Appraisal

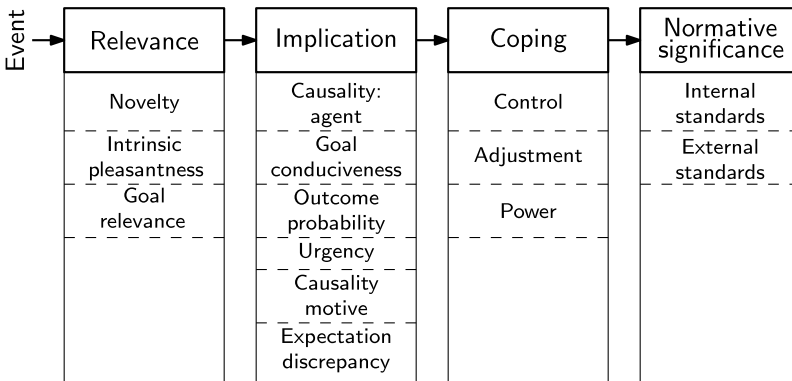
The **evaluative tradition** is instantiated by appraisal theories of various kinds. At the core of this stream of thought lies the idea that an emotion is to be described in terms of many components. It is "an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of a [...] stimulus-event" (Scherer 2005). The five subsystems are cognitive, neurophysiological, and motivational components (respectively, an appraisal, bodily symptoms, and action tendencies), as well as motor (facial and vocal) expressions, and subjective feelings (the perceived emotional experience). The change in appraisal, in particular, consists of weighting a situation with respect to the significance it holds: "does the current event hamper my goals?", "can I predict what will happen next?", "do I care about it?". The emotion that one experiences depends on the result of such evaluations, and can be thought of as *being caused* or as *being constituted* by those evaluations (e.g., in Scherer [2005] appraisals lead to emotions, in Ellsworth and Smith [1988] appraisals are themselves emotions).

Criteria used by humans to assess a situation are in principle countless, but there is a finite number that researchers in psychology have come up with in relation to emotion-eliciting events. For Ellsworth and Smith (1988), they are six: *pleasantness* (how pleasant an event is; likely to be associated with joy, but not with disgust), *effort* (how much effort an event can be expected to cause; high for anger and fear), *certainty* (how certain the experiencer is about what is happening; low in the context of hope or surprise), *attention* (the degree of focus that is devoted to the event; e.g., low, with boredom or disgust), *own responsibility* (how much responsibility the experiencer of the emotion holds for what has happened; high when feeling challenged or proud), and *own control* (how much control the experiencer feels to have over the situation; low in the case of anger). Ellsworth and Smith (1988) found these dimensions to be powerful enough to distinguish 15 emotion categories (as shown in Table 1). We follow their approach closely, but regard a larger set of variables based on Smith and Ellsworth (1985), Scherer and Wallbott (1997), and Scherer and Fontaine (2013).

Scherer and Fontaine (2013) propose a more high-level and structured approach. Figure 3 illustrates their appraisal module as a multi-level sequential process, which comprises four appraisal objectives that unfold orderly over time. First, an event is evaluated for the degree to which it affects the experiencer (Relevance) and its consequences affect the experiencers' goals (Implication). Then, it is assessed in terms of how well the experiencer can adjust to such consequences (Coping Potential), and how the event stands in relation to moral and ethical values (Normative Significance). Each objective is pursued with a series of checks. For instance, organisms scan the Relevance of the environment by checking its novelty, which in turn determines whether the stimulus demands further examination; the Implication of the emotion stimulus is estimated by attributing the event to an agent, by checking if it facilitates the achievement of goals, by attempting to predict what outcomes are most likely to occur; the Coping Potential of the self to adapt to such consequences is checked, for example, by appraising who is in control of the situation; as for the Normative Significance, an event is evaluated

**Table 1**  
The representation of emotions along six appraisal dimensions, according to Smith and Ellsworth (1985, Table 6).

| Emotion     | Unpleasant | Responsibility | Uncertainty | Attention | Effort | Control |
|-------------|------------|----------------|-------------|-----------|--------|---------|
| Happiness   | -1.46      | 0.09           | -0.46       | 0.15      | -0.33  | -0.21   |
| Sadness     | 0.87       | -0.36          | 0.00        | -0.21     | -0.14  | 1.15    |
| Anger       | 0.85       | -0.94          | -0.29       | 0.12      | 0.53   | -0.96   |
| Boredom     | 0.34       | -0.19          | -0.35       | -1.27     | -1.19  | 0.12    |
| Challenge   | -0.37      | 0.44           | -0.01       | 0.52      | 1.19   | -0.20   |
| Hope        | -0.50      | 0.15           | 0.46        | 0.31      | -0.18  | 0.35    |
| Fear        | 0.44       | -0.17          | 0.73        | 0.03      | 0.63   | 0.59    |
| Interest    | -1.05      | -0.13          | -0.07       | 0.70      | -0.07  | -0.63   |
| Contempt    | 0.89       | -0.50          | -0.12       | 0.08      | -0.07  | -0.63   |
| Disgust     | 0.38       | -0.50          | -0.39       | -0.96     | 0.06   | -0.19   |
| Frustration | 0.88       | -0.37          | -0.08       | 0.60      | 0.48   | 0.22    |
| Surprise    | -1.35      | -0.94          | 0.73        | 0.40      | -0.66  | 0.15    |
| Pride       | -1.25      | 0.81           | -0.32       | 0.02      | -0.31  | -0.46   |
| Shame       | 0.73       | 1.31           | 0.21        | -0.11     | 0.07   | -0.07   |
| Guilt       | 0.60       | 1.31           | -0.15       | -0.36     | 0.00   | -0.29   |



**Figure 3**  
Sequence of appraisal criteria adapted from Sander, Grandjean, and Scherer (2005) and Scherer and Fontaine (2013). High-level categories represent four appraisal objectives, with the item inside the dashed boxes corresponding to the relative checks.

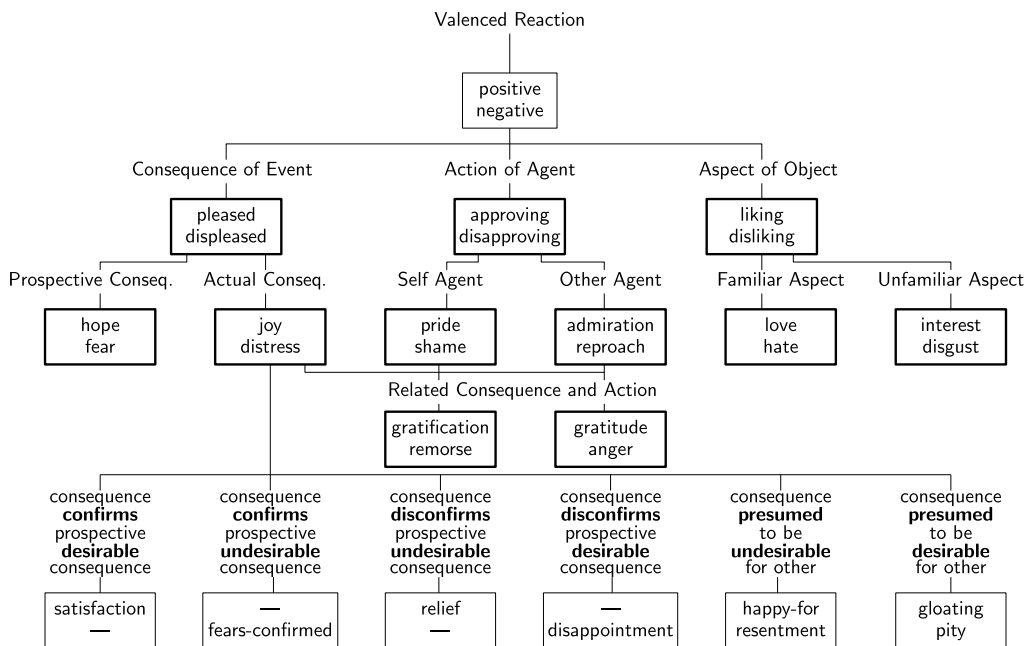
against internal, personal values that deal with self-concepts and self-esteem, as well as shared values in the social and cultural environment to which the experiencer belongs. Therefore, similar to valence, arousal, and dominance, appraisals can be interpreted as a dimensional model of emotions, namely, a model that is based on people’s interaction with the surrounding environment.

Despite different objectives, all such checks possess an underlying dimension of valence (Scherer, Bänziger, and Roesch 2010). That is, one always represents the result of a check as positive or negative for the organism: For intrinsic pleasantness, valence amounts to a concept of pleasure; for goal relevance, to an idea of satisfaction; for coping potential, to a sense of power; it involves self- or ethical worthiness in the case of internal and external standards compatibility, and the perceived predictability for novelty (with a positive valence being a balanced amount of novelty and

unpredictability—otherwise a too sudden and unpredictable event could be dangerous, while a too familiar one could be boredom-inducing). The outcome of the appraisal process is thus dependent on subjective features such as personal values, motivational states, and contextual pressures (Scherer, Bänziger, and Roesch 2010). Two people with different goals, cultures, and beliefs might produce different evaluations of the same stimulus.

Another model that falls in the evaluative tradition is the OCC model, in which emotions emerge deterministically from logic-like combinations of evaluations (e.g., *if* a condition holds, *then* a specific valenced reaction follows). We visualize the OCC in Figure 4. The model formalizes the cognitive coordinates that rule more than 20 emotion phenomena (shown in the figure in the bold boxes) within a hierarchy that develops according to how specific components interact with one another: It starts with three eliciting conditions, namely, consequences of events, agents’ actions, and aspects of objects, which spread out according to how they are appraised with different mental representations (respectively, goals, norms/standards, and tastes/attitudes) based on some binary criteria, like desirability-undesirability. A path in the hierarchy, corresponding to a specific instantiation of such components, fires an emotion (e.g., love stems from the liking of an object). Like other appraisal approaches, the OCC model can differentiate emotions with respect to their situational meanings, but it sees emotions more as a descriptive structure of prototypical situations than as a process (Clore and Ortony 2013).

The rigorously logical view of OCC makes it attractive for computational studies; in fact, this model is applied also in NLP. Both Shaikh, Prendinger, and Ishizuka (2009) and Udochukwu and He (2015) propose rules to measure some variables that come from the theory of Clore and Ortony (2013): Valence (hence desirability, compatibility with goals



**Figure 4**  
The OCC model, drawn after the depiction of Steunebrink, Dastani, and Meyer (2009, Figure 2).

and standards, and pleasantness) is represented with lexicons that associate objects and events with positivity or negativity; a confirmation status is associated with the tense of the text; and causality is modeled with the help of semantic and dependency parsing. These variables are combined with rules to infer an emotion category for the text.

This logics-based combination of variables has an arguable limitation. It treats appraisals in isolation, focusing solely on those that have a textual realization; consequently, the classification task is reduced to a deterministic decision that disregards the probability distributions across all appraisal variables. This issue has been bypassed by the work of Hofmann et al. (2020), which represents the first attempt to measure emotion-related appraisals in the NLP panorama. They annotate a corpus of event descriptions with the dimensions of Smith and Ellsworth (1985), and on that, they train classifiers that predict emotions and appraisals. Processing the variables in a probabilistic manner, these systems can handle texts with an opaque appraisal “substrate” better than OCC-based models; they are also better suited for inferring emotions from the underlying (predicted) appraisals. However, because it can count on a comparably small corpus, this work falls short in showing if emotion analysis benefits from the use of appraisals.

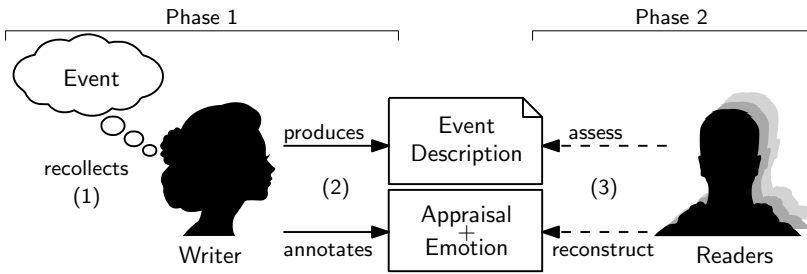
Besides their promising application in classification tasks, appraisal theories have additional significance for NLP. The cognitive component that is directly involved in the emergence of emotion experiences actually plays a role also in humans’ decoding of emotions. People’s empathy and the ability to assume the affective perspective of others is guided by their assessment of whether a certain event might have been important, threatening, or convenient for those who lived through it (Omdahl 1995). Motivated by this, Hofmann, Troiano, and Klinger (2021) analyze if readers find sufficient information in text to judge appraisal dimensions, and compare the agreement among annotators when they have access to the emotion of a text (as disclosed by the texts’ writers) to when they do not. Their results show that having knowledge about emotions boosts the annotator’s agreement on appraisals by a substantial amount. In a follow-up study (Troiano et al. 2022), we focus on experiencer-specific appraisal and emotion modeling, thus combining semantic role labeling with emotion classification. We annotate the variables that we also consider in the present article (described in Section 4.1.1), but with the help of trained experts rather than via crowdsourcing and on a smaller scale.

In summary, the components of emotions discussed by appraisal theories are relevant in this field at various levels, but related studies in NLP have some pitfalls that are left unresolved. Notably, they use limited sets of appraisals, fail to provide evidence that appraisals can help emotion classification, and disregard how well the texts’ annotators can judge appraisals in the first place. We address these gaps by building a large corpus of texts annotated with a broad set of appraisal dimensions, and by comparing the agreement that other annotators achieve *with the original emotion experiencer* (i.e., the writers who produced the texts).

### 3. Contextualization in Emotion Annotation Reliability Research

#### 3.1 Overview of Study Design

In this article, we build a novel resource to understand if appraisal theories are suitable for emotion modeling, and how well computational models can be expected to perform when interpreting textual event descriptions. We visualize our set-up in Figure 5, and discuss it in more detail in Section 4. Crowdsourced writers are tasked to remember an event that caused a particular emotion in them (1). They describe it and report their



**Figure 5**  
Overview of study design.

evaluation and subjective experience in that circumstance (2), including their appraisals. By assessing that description, other annotators (i.e., readers) attempt to reconstruct both the original emotion and the appraisal of the event experiencer (3).

As in other fields, corpus creation efforts in emotion analysis follow the practice of comparing the judgments of multiple coders and quantifying their agreement. Typically this is done considering only the annotations of the readers, as those of the writers of texts are often not available. That way, it is possible to gain insights into their reliability, but the correctness of their judgments (i.e., if they agree with the writers) cannot be established—a design choice that in fields other than NLP has been shown to affect the inter-annotator results drastically (see Section 3.2). Instead, we compare the annotations resulting from (2) with those collected in (3).

In the following, we review related work in NLP and in psychology that revolves around the emotion recognition reliability of humans, which influences our data collection procedure.

### 3.2 Emotion Recognition Reliability in Psychology

The problem of recognizing emotions has concerned the developments of emotion theories from early on. In the book *The Expression of the Emotions in Man and Animals* (1872), Darwin focuses on many external manifestations, namely, facial expressions and physiological reactions (e.g., muscle trembling, perspiration, change of skin color), claimed to be discriminative signals that allow understanding what others feel. Such observations are deepened by Paul Ekman, who introduces a coding scheme of facial muscle movements to assess emotion expressions quantitatively (Ekman, Friesen, and Ancoli 1980; Ekman and Friesen 1978).

Ekman also studies quantitatively if emotions can be identified by people who are not directly experiencing them. Focusing on the intercultural aspect of this ability, he asks if “a particular facial expression [signifies] the same emotion for all peoples” (Ekman 1972, p. 207). He recites a study in which the culture of emotion judges did not show a significant impact on their agreement (Ekman 1972, p. 242f.). In that study, Japanese and American individuals were presented with depictions of facial expressions, and they agreed on the recognized emotions with an accuracy of .79 and .86, respectively. These numbers measured the quality of annotation from within the observers’ groups. However, by comparing the coders’ decisions with the actual emotion felt by the depicted individuals, accuracy dropped to .57 and .62 (with .50 being chance). Brief, quantifying agreement returns substantially different results, depending on whether it is measured among judges of the emotion felt by others, or between the

same judges and those “others.” This constitutes an important insight for our study: We investigate agreements among external annotators, and compare their judgments with the self-assessments of the first-hand emotion experiencers.

The fact that emotions cannot be perfectly identified by interpreting facial expressions has motivated a myriad of studies after Ekman. Actually, not all emotions are equally difficult to recognize. Mancini et al. (2018) find that, at least among pre-adolescents, happiness is more easily identified than fear, and further, that there is a relation between the recognition performance and the emotion state of the person carrying it out. Other factors also influence this task. Döllinger et al. (2021) review them, pointing to peer status and friendship quality (Wang et al. 2019), to the possible state of depression of the observers (Dalili et al. 2015), and to their personality traits (Hall, Mast, and West 2016)—conscientiousness and openness are positively correlated to the ability to recognize nonverbal expressions of emotions, while shyness and neuroticism are negatively associated with it (Hall, Mast, and West 2016). We also assess personality traits, and state-specific variables in our study.

### 3.3 Reliability of Emotion Annotation in Text

Computational linguistics commonly deals with spontaneously generated text. Domains that have received substantial attention are news headlines and articles, literature, everyday dialogues, and social media. The field of emotion analysis focuses on these as well, particularly to learn the tasks of emotion classification and intensity regression. Depending on the domain in question, the emotion to be classified is either the one expressed by the writer (e.g., in social media) or one that the reader experiences (e.g., with poetry and news). In both cases, the standard approach to building emotion corpora is, first, to have multiple people annotating its texts, and second, to measure their agreement.

If the variables to be predicted/annotated are continuous, agreement can be calculated with correlation or distance measures, despite not being originally designed for inter-coder agreement. Examples are Pearson’s  $r$  or Spearman’s  $\rho$ , root mean square error (RMSE), and mean absolute error. This holds for annotations taking place both on Likert scales (what we do in this article) and via best-worst scaling (Louviere, Flynn, and Marley 2015). Various measures have been formulated specifically for the comparison of annotations with discrete categories. Cohen’s  $\kappa$ , for instance, quantifies agreement between two annotators, and Fleiss’  $\kappa$  (Cohen 1960) is its generalization to multiple coders. Cohen’s  $\kappa$  is defined as  $\kappa = \frac{p_o - p_e}{1 - p_e}$ , where  $p_o$  is the observed probability of agreement, and  $p_e$  is the expected agreement based on the distribution of labels assigned by the annotators individually. In multi-class classification problems, it is common to calculate  $\kappa$  across all classes, while in multi-label problems, this is done for each class separately.

With skewed label distributions,  $\kappa$  might underestimate agreement and assume low scores. For this reason, authors often report other evaluations in addition. Typical options are a between-annotator accuracy ( $\text{acc} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{FN} + \text{TN}}$ ), where the decision of one annotator is considered a gold standard and the other is treated as a prediction, and an inter-annotator agreement  $F_1 = \frac{\text{TP}}{\text{TP} + \frac{1}{2}(\text{FP} + \text{FN})}$  (where TP is the count of true positives, FP of false positives, TN of true negatives, and FN of false negatives). Because classification models are also evaluated with the latter two measures, their performance can be directly compared to humans’. This is valuable for at least two reasons: First, one can treat inter-annotator agreement as a reasonable upper bound for the models. For

instance, if annotators agree with one another or with the original emotion label of text only to a certain extent, models showing analogous performance are still acceptable. In fact, the purpose and plausibility of models that achieve better results than humans is hard to interpret. Second, agreement can be leveraged to assess the quality of datasets. For instance, Mohammad (2012) provide a large corpus of tweets labeled with (emotion) hashtags. Such an approach can be considered noisy, because a hashtag does not necessarily express the emotion of the writer or of the text content. Still, its creators find that an emotion classifier reaches similar results on the “self-labeled” data as it does on manually labeled texts (40.1  $F_1$ ), suggesting that the quality of labels is comparable in the human and the automatic settings.

Inter-annotator agreement scores vary based on the domain of focus. Haider et al. (2020) find an average  $\kappa = .7$  and  $F_1 = .77$  on poems for the annotation of the perceived emotion. Aman and Szpakowicz (2007) report a  $\kappa$  between .6 and .79 for blogs, where joy shows the highest agreement and surprise the lowest. Similar numbers are obtained by Li et al. (2017) on dialogues (.79, although the measure is unspecified). The  $\kappa$  of annotators judging the tweets in Schuff et al. (2017) ranged from .57, for trust, and .3, for disgust and sadness. Looking at correlation measures, for news headlines, Strapparava and Mihalcea (2007) compute an average emotion intensity correlation between annotators of .54, with sadness having the highest score (.68) and surprise the lowest (.36). Preotiu-Pietro et al. (2016), who annotate Facebook posts, report correlations of .77 for valence and .83 for arousal.

Previous work shows that the agreement between annotators in emotion analysis is limited in comparison to other NLP tasks. In the domain of fairy tales, Alm, Roth, and Sproat (2005) find a  $\kappa$  between .24 and .51, depending on the annotation pair. Building their corpus of news headlines, Bostan, Kim, and Klinger (2020) report an agreement of  $\kappa = .09$ , likely due to the fact that headline interpretation can be sensitive to one’s context and background. Another factor that influences (dis)agreements is the annotation perspective that coders are required to assume. Buechel and Hahn (2017b) compare judgments about the readers’ and the writers’ emotion (where the latter is inferred by the readers themselves and not indicated by the authors of the texts), providing evidence that taking the perspective of writers promotes the overall annotation quality. In a similar vein, Mohammad (2018) analyses the role of personal information on VAD-based judgments, much in line with the multiple works in psychology (introduced in Section 3.2) that delve into the annotators’ personal information (e.g., mental disorders, personality traits) in order to better understand their annotation performance. While creating a VAD lexicon, Mohammad (2018) collects data about the annotators’ age, gender, agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience, and points out a significant relation between (nearly all) the demographic/personality traits of people and their task agreement.

Across such a broad literature, agreement between readers and writers is mostly disregarded. The texts’ authors are rarely leveraged as annotators. In fact, corpora containing information about their emotion are typically constructed via self-labeling, either with hashtags (Mohammad 2012) and emojis (Felbo et al. 2017) or through emotion-loaded phrases that are looked for in the text (Klinger et al. 2018). The only work that we are aware of, and which involves text writers, is that of Troiano, Padó, and Klinger (2019). They ask crowdworkers to generate event descriptions based on a prompting emotion, and then compare it to the emotion inferred by the readers from text in terms of accuracy. Their work is a blueprint for our crowdsourcing set-up, but it does not contain any appraisal-related label. In a follow-up work, they assign appraisal dimensions to the same descriptions with the help of three carefully trained annotators

(Hofmann et al. 2020), who achieve average  $\kappa = .31$  for the variable of *attention*, *.31 for certainty*, *.32 for effort*, *.89 for pleasantness*, *.63 for own responsibility*, *.58 for own control*, *.37 for situational control*, and *.53* as an overall average. These numbers are the only agreement scores for appraisal dimensions that are available up-to-date (but they are only computed among readers).

#### 4. Corpus Creation

To the best of our knowledge, there are no linguistic resources to study affect-oriented appraisals. Therefore, as a starting point for our investigation, we built an emotion and appraisal-based corpus of event descriptions. The creation of crowd-enVENT took place over a period of 8 months (from March to December 2021), and it was divided into two consecutive phases: a first phase for generating the data and a second one to validate it. These phases are both represented in Figure 5. Phase 1 consists of generators *recollecting* personal events (Step (1)) and *writing and annotating* them ((Step (2)); Phase 2 consists of validators *assessing* the events produced in Phase 1 and *reconstructing the emotion and the appraisals* (Step (3)).

The two phases were designed to mirror each other with respect to the considered variables, the formulation of questions, and the possible answers. In the generation phase, participants produced event descriptions and informed us about their appraisals and emotions. The authors' appraisals and emotions were then reconstructed in the validation phase by multiple readers for a subsample of texts. In both, participants disclosed their emotional state at present, their personality traits, and demographic information. As a result, part of crowd-enVENT is annotated from two different perspectives. One, corresponding to *generation*, is based on the recollection of evaluations as they were originally made when the event happened; the other, the *validation*, is about inferred evaluations. In this article, we refer to the authors/writers of the event descriptions also as generators and to the readers as validators (Phase 1 and Phase 2). Both are considered participants in the study and act as text annotators. The full annotation questionnaires, including the comparison between the generation and the validation phases, is depicted in the Appendix, Table 16.<sup>4</sup>

Annotating well-established corpora with emotions and appraisals could have been a viable alternative to generating texts from scratch, but such a choice would have faced principled criticism. Available resources provide no ground truth appraisals, impeding evaluating if the readers' annotations are correct. This is a problem, because judgments concerning emotions are highly subjective, and this is also assumed to be the case for the cognitive evaluations of events—they hinge on people's world knowledge and on their perception of the stimulus event, which is not necessarily shared between the texts' writers and the annotators. Hofmann et al. (2020) and Hofmann, Troiano, and Klinger (2021) have enriched an existing corpus of event descriptions with evaluative dimensions, asking annotators to interpret how the texts' authors assessed such events in real life (similar to our validation set-up). By operating in the absence of a ground truth annotation, they could not determine if the evaluations were well reconstructed. This is the gap that we fill with crowd-enVENT.

4 PDF printouts of the questionnaires showing the original design are part of the supplementary material.

## 4.1 Variable Definition

The formulation of a task concerning appraisal-related judgments depends on the specific theory that one considers. As a matter of fact, different research lines are rooted in a common conceptual framework, but they are still characterized by internal differences. For example, appraisal dimensions change from one work to the other, or are qualified in different ways. Below we establish the theoretical outset of our questionnaire, describing how we defined the variables of interest: appraisals (Section 4.1.1), emotions (Section 4.1.2), and some supplementary variables (Section 4.1.3).

**4.1.1 Appraisals.** We adopt the schema proposed by Sander, Grandjean, and Scherer (2005), Scherer, Bänziger, and Roesch (2010), and Scherer and Fontaine (2013). They group appraisals into the four categories shown in Figure 3, which represent specific evaluation objectives. There is a first assessment aimed at weighing the relevance of an event, followed by an estimate of its consequences, and of the experiencer's own capability to cope with them; last comes the assessment of the degree to which the event diverges from personal and social values.

Each objective is instantiated by a certain number of evaluation checks, and each check can be broken down into one or many appraisal dimensions. Namely, 1. *suddenness*, 2. *familiarity*, 3. *predictability*, 4. *pleasantness*, 5. *unpleasantness*, 6. *goal-relatedness*, 7. *own responsibility*, 8. *others' responsibility*, 9. *situational responsibility*, 10. *goal support*, 11. *consequence anticipation*, 12. *urgency of response*, 13. *anticipated acceptance of consequences*, 14. *clash with one's standards and ideals*, 15. *violation of norms or laws*. These dimensions illustrate properties of events and their relation to the event experiencers. Used by Scherer and Wallbott (1997) to create the corpus ISEAR,<sup>5</sup> they constitute the majority of appraisals judged by the annotators in our study as well. Figure 6 collocates them (as numbered items) under the corresponding checks (the underlined texts).

The above items can also be found in other studies. For instance, while formulating the questions differently, Smith and Ellsworth (1985) analyze pleasantness, certainty, and responsibility (they merge *others'* and *situational responsibility* together). In addition, they directly tackle a handful of dimensions that are only implicit in Scherer and Wallbott (1997), specifically 16. *attention*, and 17. *attention removal*, two assessments that can be considered related to the relevance and the novelty of an event, and 18. *effort*, which is the understanding that the event requires the exert of physical or mental resources, and is therefore close to the assessment of one's potential. Smith and Ellsworth (1985) also divide the check of control into the more fine-grained dimensions of 19. *own control of the situation*, 20. *others' control of the situation*, and 21. *chance control*.

We integrate the two approaches of Scherer and Wallbott (1997) and Smith and Ellsworth (1985), by adding the latter six criteria to our questionnaire. We include *attention* and *attention removal* under Novelty in Figure 3, *effort* as part of the Adjustment check, and *own*, *others'*, and *chance control* inside Control. This enables us to align with the NLP set-up described in Hofmann et al. (2020) and Hofmann, Troiano, and Klinger (2021),<sup>6</sup> and to have a much larger coverage of dimensions motivated by psychology.

5 Original questionnaire: [https://www.unige.ch/cisa/files/3414/6658/8818/GAQ\\_English\\_0.pdf](https://www.unige.ch/cisa/files/3414/6658/8818/GAQ_English_0.pdf).

6 Hofmann et al. (2020) and Hofmann, Troiano, and Klinger (2021) use a subset of our dimensions but a different nomenclature. The following is the mapping between their variables and ours: attention → attention, responsibility → own responsibility, control → own control, circumstantial control → chance control, pleasantness → pleasantness, effort → effort; certainty → consequence anticipation. Certainty (about what was going on during an event) and consequence anticipation are close but not identical

| Relevance   | Implication   | Coping  | Normative significance   |
|---|---|---|--|
| <u>Novelty</u><br>(1) suddenness<br>(2) familiarity<br>(3) predictability<br>(16) attention*<br>(17) attention removal*<br><br><u>Intrinsic pleasantness</u><br>(4) pleasant<br>(5) unpleasant<br><br><u>Goal relevance</u><br>(6) goal-related | <u>Causality: agent</u><br>(7) own responsibility<br>(8) others' responsibility<br>(9) situational responsibility<br><br><u>Goal conduciveness</u><br>(10) goal support<br><br><u>Outcome probability</u><br>(11) consequence anticipation<br><br><u>Urgency</u><br>(12) response urgency<br><br>(Causality: motive)<br>(Expectation discrepancy) | <u>Control</u><br>(19) own control*<br>(20) others' control*<br>(21) chance control*<br><br><u>Adjustment</u><br>(13) anticipated acceptance<br>(18) effort*<br><br>(Power) | <u>Internal standards compatibility</u><br>(14) clash with own standards/ideals<br><br><u>External standards compatibility</u><br>(15) clash with laws/norms |

**Figure 6** Appraisal objectives (on top) with their relative checks (underlined) and the appraisal dimensions investigated in our work (numbered). Checks in parenthesis have been proposed by Scherer and Wallbott (1997) but are not included in our study. Items marked with an asterisk come from Smith and Ellsworth (1985).

Note, however, that we disregard a few dimensions from Scherer and Wallbott (1997). In Figure 6 (adapted from Scherer and Fontaine [2013]), they correspond to the checks “Causality: motive,” “Expectation discrepancy,” and “Power.” As they differ minimally from other appraisals, they would complicate the task for the annotators.<sup>7</sup>

Research in psychology also proposes some best practices for collecting appraisal data. Yanchus (2006) in particular casts doubt on the use of questions that annotators typically answer to report their event evaluations (e.g., “Did you think that the event was pleasant?”, “Was it sudden?”). Asking questions might bias the respondents because it allows people to develop a theory about their behavior in retrospect. Statements instead leave them free to recall if the depicted behaviors applied or not (e.g., “The event was pleasant.”, “It was sudden.”). In accordance with this idea, we reformulate the questions used in Scherer and Wallbott (1997) and Smith and Ellsworth (1985) as affirmations, aiming to preserve their meaning and to make them accessible for crowdworkers. Section A1 in the Appendix reports a comparison between our appraisal statements and the original questions, as well as the respective answer scales.

The resulting affirmations are detailed below. In our study, each of them has to be rated on a 1-to-5 scale, considering how much it applies to the described event (1: “not at all”, 5: “extremely”). The concept names in parentheses are canonical names for the variables that we use henceforth in this article.

concepts. After including the first in a pre-test of our study, we observed that its annotation was monotonous across both emotions and workers (an event about which people can produce a text is likely judged as one that they understood). We discard it.

<sup>7</sup> While our crowdsourcing set-up requires laypeople to accomplish the task with no previous training, no formal knowledge about appraisals, nor their relation to emotions, Scherer’s (1997) questionnaire was carried out in-lab.

*Novelty Check.* According to Smith and Ellsworth (1985), a key facet of emotions is that they arise in an environment that requires a certain level of attention. Akin to the assessment of novelty, the evaluation of whether a stimulus is worth attending or worth ignoring can be considered the onset of the appraisal process. Their study treats attention as a bipolar dimension, which goes from a strong motivation to ignore the stimulus to devoting it full attention. Similarly, we ask:

16. I had to pay attention to the situation. (*attention*)
17. I tried to shut the situation out of my mind. (*not consider*)

Stimuli that occur abruptly involve sensory-motor processing other than attention. To account for this, the check of novelty develops along the dimensions of suddenness, familiarity, and event predictability, respectively formulated as:

1. The event was sudden or abrupt. (*suddenness*)
2. The event was familiar. (*familiarity*)
3. I could have predicted the occurrence of the event. (*event predictability*)

*Intrinsic Pleasantness.* An emotion is an experience that feels good/bad (Clore and Ortony 2013). This feature is unrelated to the current state of the experiencer but is intrinsic to the eliciting condition (i.e., it bears pleasure or pain):

4. The event was pleasant. (*pleasantness*)
5. The event was unpleasant. (*unpleasantness*)

*Goal Relevance Check.* As opposed to intrinsic pleasantness, this check involves a representation of the experience for the goals and the well-being of the organism (e.g., one could assess an event as threatening). We define goal relevance as:

6. I expected the event to have important consequences for me.  
(*goal relevance*)

*Causal Attribution.* Tracing a situation back to the cause that initiated it can be key to understanding its significance. The check of causal attribution is dedicated to spotting the agent responsible for triggering an event, be it a person or an external factor (one does not exclude the other):

7. The event was caused by my own behavior. (*own responsibility*)
8. The event was caused by somebody else's behavior. (*others' responsibility*)
9. The event was caused by chance, special circumstances, or natural forces.  
(*situational responsibility*)

Scherer and Fontaine (2013) also include a dimension related to the causal attribution of motives (“Causality: motive” in Figure 6), which is similar to the current one but involves intentionality. We leave intentions underspecified, such that for 7., 8., and 9., the agents’ responsibility does not necessarily imply that they purposefully triggered the event.

*Goal Conduciveness Check.* The check of goal conduciveness is dedicated to assessing whether the event will contribute to the organism’s well-being:

10. I expected positive consequences for me. (*goal support*)

Goal relevance (6.) differs from this appraisal: An event might be relevant to one’s goals and needs while not being compatible with them (it might actually be deemed important precisely because it hampers them).

*Outcome Probability Check.* Events can be distinguished based on whether their outcome can be predicted with certainty. For instance, the loss of a dear person certainly implies a future absence, while taking a written exam could develop in different ways. Annotators recollected whether they could establish the consequences of the event, at the moment in which it happened, by reading:

11. I anticipated the consequences of the event. (*anticip. conseq.*)

Scherer and Fontaine (2013) identify one more check about consequences: People picture the potential outcome of an event based on their prior experiences, and then evaluate if the actual outcome fits what they expected. We refrain from introducing *expectation discrepancy* (under “Implication,” in Figure 6) in our repertoire. For one, it is hard to distinguish from *outcome probability check* in a crowdsourcing setting; but mainly, such a dimension clashes with our attempt to induce the mental evocation of their state *at the time in which the event happened* (e.g., when taking an emotion-eliciting exam), and not when its consecutive developments became known (e.g., when learning, later, if they passed). Briefly, 11. aims at understanding if people could picture potential outcomes of the event, and not if their prediction turned out correct.

*Urgency Check.* One feature of events is how urgently they require a response. This depends on the extent to which they affect the organism. High priority goals compel immediate adaptive actions:

12. The event required an immediate response. (*urgency*)

*Control Check.* This group of evaluations concerns the ability of an agent to deal with an event, specifically to influence its development. At times, “event control” is in the hands of the experiencer (irrespective of whether they are also responsible for initiating it); other times it is held by external entities; and yet other times the event is dominated by factors like chance or natural forces (Smith and Ellsworth 1985). Accordingly, we formulate the following three statements:

19. I was able to influence what was going on during the event. (*own control*)

20. Someone other than me was influencing what was going on. (*others' control*)
21. The situation was the result of outside influences of which nobody had control. (*chance or situational control*)

We do not focus on “Power” (under Coping in Figure 6), the assessment of whether agents can control the event at least in principle (e.g., if they possess the physical or intellectual resources to influence the situation).

*Adjustment.* Related to control is the evaluation of how well an experiencer will cope with the foreseen consequences of the event, particularly with those that cannot be changed:

13. I anticipated that I would easily live with the unavoidable consequences of the event. (*accept. conseq.*)

A different dimension of adjustment check is motivated by Smith and Ellsworth (1985). Emotions can be differentiated on the basis of their physiological implications, similar to the notion of arousal in the dimensional models of emotion. More precisely, individuals anticipate if and how they will expend any effort in response to an event (e.g., fight or flight, do nothing). We phrase this idea as:

18. The situation required me a great deal of energy to deal with it. (*effort*)

*Internal and External Standards Compatibility.* The significance of an event can be weighted with respect to one's personal ideals and to social codes of conduct. Two appraisals can be defined on the matter:

14. The event clashed with my standards and ideals. (*internal standards*)
15. The actions that produced the event violated laws or socially accepted norms. (*external norms*)

The first pertains to an event colliding with desirable attributes for the self, with one's imperative motives of righteous behavior. The second concerns its evaluation against the values shared in a social organization. Both guide how experiencers react to events.

*4.1.2 Emotion Selection.* Our choice of emotion categories is closely related to that of appraisals, because different emotions are marked by different appraisal combinations. In the literature, such a relationship is addressed only for specific emotions. Therefore, we motivate the selection of this variable following appraisal scholars once more.

We consider the emotions that one or several studies claim to be associated with the appraisals of Section 4.1.1. We include all emotions from Scherer and Wallbott (1997) as a first nucleus. They are *anger, disgust, fear, guilt, joy, and sadness* (i.e., Ekman's basic set),

plus *shame*. On top of these, we use *pride*, which is tackled with respect to the objectives of *relevance*, *implication*, *coping*, and *normative significance* (Manstead and Tetlock 1989; Roseman 1996, 2001; Smith and Ellsworth 1985; Scherer, Schorr, and Johnstone 2001a). The last two works also comprise a discussion of *boredom*, and Roseman, Spindel, and Jose (1990) and Roseman (1984) examine *surprise*, as well as the positive emotion of *relief*. *Trust*, an emotion present in Plutchik's wheel, is linked to the appraisal of goal support (Lewis 2001), and to the check of control (Dunn and Schweitzer 2005).

We regard the reference to appraisal theories as a sufficiently strong motivation to make use of these discrete emotions. It enables us, for instance, to verify if the patterns of appraisals found in our data correspond to those proposed by theorists, as a signal that the annotators' understanding of the variables under consideration match the experts'. Moreover, compared with dimensional models of affect, discrete categories facilitate our attempt to explain how the annotators' emotion judgments vary as their appraisal ratings vary. Lastly, VAD concepts can be deemed implicit to the chosen appraisals dimensions (e.g., valence  $\approx$  *pleasantness* – *unpleasantness*, arousal  $\approx$  *attention* – *not consider*, dominance  $\approx$  *own control*). In this sense, opting for a VAD annotation would be redundant.

We define our questionnaires with these 12 emotion labels. We add in addition a *no-emotion* category, because events can be appraised along our 21 dimensions even if they elicit no emotion. The neutral class serves as a control group to observe differences in appraisal between emotion- and non-emotion-inducing events. However, not all texts generated for this label in crowd-enVENT describe uninfluential or unemotional events. As pointed out later, many of them depict rather dramatic circumstances that, perhaps exceptionally, did not stir up the experiencers.

**4.1.3 Other Variables.** We use two other groups of variables regarding the described emotion-inducing circumstances and the type of personas providing the judgments. The first group deals with emotion and event properties; the other focuses on features of the study participants. Note that we do not aim at analyzing all these variables in the current paper—they potentially serve future studies based on our data.

*Properties Relative to Emotions and Events.* It is reasonable to assume that the same event is appraised differently depending on its specific instantiation. For example, while standing in a queue, an emoter of boredom could feel more in control of the situation than another, depending on how long each of them persists in it, or how intensely the event affects them. Motivated by this, we consider the *duration of the event*, the *duration of the emotion* (with the possible answers “seconds,” “minutes,” “hours,” “days,” and “weeks”<sup>8</sup>), and the *intensity* of the experience (to be rated on a 1 to 5 scale, ranging from “not at all” to “extremely”).

*Properties of Annotators.* Annotation endeavors in emotion analysis show comparably low inter-coder agreements, as discussed in Section 3. We hence collect some properties of the annotators, in order to understand how they influence (dis)agreements among emotion and appraisal judgments.

One property concerns demographic information. The self-perceived belonging to a sociocultural group can determine one's associations to specific events. For that, we request participants to disclose their *gender* (“male,” “female,” “gender variant/non

8 For the study of neutral events, the emotion duration variable comprises the option “I had none.”

conforming,” and “prefer not to answer”) and *ethnicity* (either “Australian/New Zealander,” “North Asian,” “South Asian,” “East Asian,” “Middle Eastern,” “European,” “African,” “North American,” “South American,” “Hispanic/Latino,” “Indigenous,” “prefer not to answer,” or “other”). We further ask them about their *age* (as an integer), as well as their *highest level of education* (among “secondary education,” “high school,” “undergraduate degree,” “graduate degree,” “doctorate degree,” “no formal qualifications,” and “not applicable”), which might affect the clarity of the texts they write, or the way in which they interpret what they read.

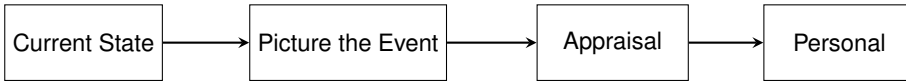
People’s personality traits are another attribute that guides their judgments about mental states. We follow the Big-Five personality measure of Gosling, Rentfrow, and Swann Jr. (2003). As an alternative to lengthy rating instruments, it is a 10-item measure corresponding to the dimensions of *openness to experience* (measured positively via “open to new experiences and complex” and negatively via “conventional and uncreative”), *conscientiousness* (measured positively via “dependable and self-disciplined” and negatively via “disorganized and careless”), *extraversion* (measured positively via “extraverted and enthusiastic” and negatively via “reserved and quiet”), *agreeableness* (measured positively via “sympathetic and warm” and negatively via “critical and quarrelsome”), and *emotional stability* (measured positively via “calm and emotionally stable” and negatively via “anxious and easily upset”). Participants self-assign traits by rating each pair of adjectives on a 7-point scale, from “disagree strongly” to “agree strongly.”

As an extra link between the annotator and the annotation, we ask participants what *emotion they feel* right before entering the task on a 1–5 scale (i.e., “not at all,” “intensely”). For that, the labels presented in Section 4.1.2 need to be scored, except for the neutral label. Further, we demand that they judge the *reliability* of their own answers. This variable is instantiated in different ways for the two phases. Because writers can recall events that happened at any point in their life, some memories of appraisals might be more vivid than others, which can affect their annotations. Therefore, we deem confidence as the trustworthiness of this episodic memory, quantifying people’s belief that what they recall corresponds to what actually happened. In the validation phase, this variable measures the annotators’ confidence that the emotion they inferred from text is correct. Both are assessed on a 5-point scale, with 1 corresponding to the lowest degree of confidence.

Lastly, we notice that the goal of building and validating a corpus of self-reports potentially suffers from a major flaw. On the one hand, there is no guarantee that the described events happened in the writers’ life. It is reasonable to think that, running out of ideas, writers resorted to events that are typically emotional. On the other, readers’ judgments might depend on whether they had an experience comparable to the descriptions that they are presented with. Therefore, we ask the writers if they actually experienced the event they described, and the validators if they experienced a similar event before. We cannot assess the honesty of this answer either, but assuming it can be trusted, it represents an additional level of information to look at patterns of appraisals (e.g., how well the appraisal of events that were not really lived in first person can be reconstructed).

## 4.2 Generation

In the generation phase, annotators had the goal of describing an event that made them feel one predefined emotion (out of those in Section 4.1.2) and to label such description.



**Figure 7**

Questionnaire overview. The two phases of data creation mainly differ with respect to the block “Picture the Event”: In the generation phase, the event is recalled and described; in the successive phase, the text is read for the validators to put themselves in the shoes of the writers.

We collected their answers using Google Forms. Participants were recruited on Prolific,<sup>9</sup> a platform that allows prescreening workers based on several features (e.g., language, nationality).

We adopted a few strategies to promote data quality. First, we opened the study only to participants whose first language is English, with a nationality from the US, UK, Australia, New Zealand, Canada, or Ireland, and with an acceptance rate of  $\geq 80\%$  to previous Prolific jobs. Second, we interspersed our questionnaires with two types of attention tests: a strict test, in which a specified box on a scale had to be selected, and one in which a given word had to be typed. Third, we intervened to make automatic text corrections unlikely, by impeding the completion of our surveys via smartphones.

As we sought to have the same number of descriptions for all emotions, we organized data generation into 9 consecutive rounds. A round was aimed at collecting a certain number of tasks, based on different emotions. The first round served to verify whether our variables were understandable, record the feedback of the annotators, and adjust the questionnaire accordingly. We do not include it in crowd-enVENT. The three final rounds balanced out the data. They comprised questionnaires only for those emotions with insufficient data points, due to rejections in the previous rounds. A special treatment was reserved to *shame* and *guilt*: We considered them as two sides of the same coin, and for each we collected half as many items as for the other emotions, motivated by the affinities between the two (Tracy and Robins 2006) and the difficulty for crowdworkers to discern them (Troiano, Padó, and Klinger 2019).

Annotators could fill in more than one questionnaire (for more than one emotion, in more than one round). On average, people took our study 2.8 times, with the most productive worker contributing with 33 questionnaires. Because our expected completion time for a questionnaire was around 4 minutes, we set the payment to £0.50, that is, £7.50 per hour, with respect to the minimum Prolific wage—more details in the Appendix (Section A2., Table 14). The 6,600 approved questionnaires were submitted by 2,379 different people, for a total cost of £4825.20 (including service fees, VAT, and the pre-test round). We used these answers to compile crowd-enVENT.

While each questionnaire was dedicated to a different prompting emotion  $E$ , all of them instantiated the same template. As shown in Figure 7, there are four blocks of information. At the very beginning, participants were asked about their current emotion state. They then addressed the task of recalling a real-life event in which they felt emotion  $E$ , indicating the duration of the event, the duration of the emotion, the intensity of the experience, and their confidence. They described such experience by completing the sentence “I felt  $E$  when/because...”. For instance, people saw the text “I felt anger when/because...” for the prompting emotion  $E$ =anger, and “I felt no particular emotion when/because...” in the *no-emotion*-related questionnaire. We encouraged them

<sup>9</sup> <https://www.prolific.co>.

**Table 2**

Fully-updated list of off-limits topics used to induce event variability.

| Emotion      | Off-limits topics   |
|--------------|---|
| Anger        | reckless driving, breaking up, being cheated on, dealing with abuses and racism,  |
| Boredom      | attending courses/lectures, working, having nothing to do, standing in cues/  |
| No emotion   | waiting, shopping, cooking/eating   |
| Disgust      | vomit, defecation, rotten food, experiencing/seeing abusive behaviors, cheating,  |
| Fear         | being home/walking alone (or followed by strangers), being involved in accidents, losing sight of own kids/animals, being informed about an illness, getting on a plane |
| Guilt, Shame | stealing, lying, getting drunk, overeating, and cheating  |
| Joy, Pride   | birth events, passing tests, being accepted at school/for a job, receiving a promotion, graduating, being proposed to, winning awards, team winning matches,            |
| Relief       | death and illness, losing a job, not passing an exam, being cheated on,   |
| Sadness      | surprise parties, passing exams, getting to know someone is pregnant, getting unexpected presents, being proposed to  |
| Surprise     | being told/telling secrets, opening up about mental health  |
| Trust        |   |

to write about any event of their choice, and to recount a different event each time they took our survey, in case they participated multiple times. As complementary material, workers were provided with a list of generic life areas (i.e., health, career, finances, community, fun/leisure, sports, arts, personal relationships, travel, education, shopping, learning, food, nature, hobbies, work) that could help them pick an event from their past, in case they found such choice troublesome. Moving on to the third block of information, people rated the 21 appraisal dimensions, considering the degree to which each of them held for the described event. The survey concluded with a group of questions on demographic information, personality traits, and event knowledge.<sup>10</sup> People who participated multiple times needed to provide their demographics and personality-related data only once.

After the first three rounds, we observed that a substantial number of participants had mentioned similar experiences. For instance, *sadness* triggered many descriptions of loss or illness, and *joy* tended to prompt texts about births or successfully passed exams. The risk we incurred was to collect over-repetitive appraisal combinations. To solve the issue, we aimed at inducing higher data diversity. Starting from round 4, we re-shaped the text production task with two contrasting approaches. One served to stimulate the recalling of idiosyncratic facts. In the questionnaires based on this solution, people were invited to talk about an experience that was special to them—one that other participants unlikely had in their life. The other strategy attempted to refrain them from talking about specific events. We manually inspected the collected texts, and compiled a repertoire of recurring topics, emotion by emotion (see Table 2); hence, we presented the new participants with the topics usually prompted by *E*, and we asked them to write about something different. Because this strategy appeared to diversify the data more than the other, we kept using it in the last three rounds, updating the list of off-limits topics.

<sup>10</sup> Event knowledge was included from round 5 afterwards.

We acknowledge the artificiality of this set-up: The texts were produced by filling in a partial sentence and being tasked to recall certain events but not others. At the same time, constraining linguistic spontaneity resulted in high-quality data: Compared with a free text approach, the sentence completion framework represented a way to reduce the need for writers to mention emotion names—which we would need to remove for the validation phase—and to minimize the occurrence of ungrammaticalities. Moreover, the descriptions present constructs that are similar to productions occurring on digital communication channels (e.g., those that can be found in the corpus by Klinger et al. [2018]).

Having concluded the nine rounds, we compiled the generation side of crowd-enVENT. We discarded submissions with heavily ungrammatical descriptions and incorrect test checks (i.e., those based on box ticks, while we were lenient with type-in checks containing misspellings). For individual annotators who completed various questionnaires, we removed descriptions paraphrasing the same event, and for those who filled the last block of questions more than once, we averaged the personality traits scores. In total, we obtained 6,600 event descriptions, balanced by emotion: 275 descriptions for *guilt* and *shame*, and 550 for all other prompting emotions.

### 4.3 Validation

During the second phase of building crowd-enVENT, the texts previously produced were annotated from the perspective of the readers. This was a “validation” process in the sense that the resulting judgments can shed light on the inter-subjective validity of emotions and appraisals. We are here in line with the study by Hofmann et al. (2020) and Hofmann, Troiano, and Klinger (2021), with the difference that we move to a crowdsourcing set-up, with non-binary judgments and a larger number of annotators, texts, appraisals, and emotions.

The validation was developed in multiple rounds, preceded by a pre-test that verified the feasibility of the study on a small number of texts. The initial attempt was completed successfully and the results were included in crowd-enVENT. This motivated us to proceed using the same questionnaire (without any refinement). Five additional rounds were launched, until the target number of annotations was achieved.

We validated only a subset of crowd-enVENT, sampled with heuristic- and random-based criteria: The data was balanced by emotion (100 per label, except for guilt and shame, each of which received half the items), and it was extracted from the answers of different generators to boost the linguistic variability shown to the annotators—assuming that personal writing styles emerged from the descriptions. From a set of generation answers that respected these conditions, we randomly extracted 1,200 texts. Of those, 20 constituted the material for the pre-test. In each text, we replaced words that correspond to an emotion name with three dots (e.g., “*I felt... when I passed the exam*”), for the emotion reconstruction task to be non-trivial. This preprocessing step was accomplished through rules and heuristics. The first served to mask, for example, all words in an *E*-related text with the same lemma as *E*, or synonyms of *E* (e.g., the word “*furious*” in texts prompted by *anger*); the other to remove emotion words that contained typos.<sup>11</sup>

<sup>11</sup> The full list of masked words and phrases is in the supplementary material.

Answers were collected with the software SoSciSurvey,<sup>12</sup> which provides the possibility of creating a questionnaire dynamically, with different annotation data for each participant. Specifically, each annotator judged 5 different texts placed in a questionnaire, and each text was annotated by 5 different people, for a total of 6,000 collected judgments (i.e., 1,200 texts  $\times$  5 annotations). Moreover, to prevent texts from being re-annotated by their writers, the study was made inaccessible for all those who performed generation.

Participants were enlisted via Prolific, where we adopted the same filtering and quality checking strategies used before. Workers could take our study only once, such that the judgments of each of them would appear an equal number of times and would return a picture of the crowd's impressions appropriate to study inter-subjectivity. We encouraged them to follow the instructions with a bonus of £5 for the 5% best performing respondents (i.e., 60 crowdworkers whose appraisal reconstruction is the closest to the original ones). We estimated the completion time of a questionnaire to 8 minutes, and set the reward to £1 per participant.<sup>13</sup> As we approved 1,217 submissions, constructing the validation side of crowd-enVENT cost £2188.09 (VAT, service fees, and bonus included).

The validation questionnaire followed the one for generation. We made a few adjustments (a full comparison of the questionnaires in the two phases is in the Appendix, Table 16), but its template corresponded to that depicted in Figure 7, with most answering options mirroring those used before. Each questionnaire in the validation was not dedicated to one predefined prompting emotion. It included 5 texts that could be related to any of the emotions included in the generation phase.

The block of questions opening the survey asked people to rate their current emotion. Next, annotators were presented with a description and they were asked to put themselves in the shoes of the writers at the moment in which they experienced the event. They had to attempt to infer the emotion that the event (which corresponded to the emotion  $E$ ) elicited in the writer. Our choice to work in a mono-label setting was influenced by our compliance with the framework of Scherer and Wallbott (1997). Although their ISEAR corpus only contains writers' annotations, the validation step we added instantiates an opposite but corresponding task (i.e., emotion decoding). Thus, we put the readers in the position of providing their predominant impression about  $E$ , as were the participants in the previous (emotion encoding) phase. The alternative of picking multiple emotion alternatives for a text might have changed the annotation of the related appraisals, making crowd-enVENT and previous studies on the emotion-appraisal relationship incomparable.

The validators also had to estimate the duration of the described event and the duration of the emotion, as well as the intensity of such experience. They rated their confidence in the annotations given up to that point (i.e., how well they believed to have assessed emotion, event duration, emotion duration, and intensity). As for the variable of event knowledge, we asked workers if they had ever had an experience comparable to the one they judged. After that, they reconstructed the original appraisals of the writers. Participants repeated these steps (included in *Picture the Event* and *Appraisal* in Figure 7) consecutively for the 5 texts. Lastly, they provided personal information related to their age, gender, education, ethnicity, and personality traits, as detailed in Section 4.1.3.

---

12 <https://www.soscisurvey.de>.

13 Breakdown of costs and number of participants in the Appendix, Table 15.

Overall, the answers we collected surpassed our target number of answers (i.e., some texts were annotated more than 5 times). We randomly removed some of these accepted submissions to obtain the same amount of judgments per emotion, that we included in crowd-enVENT.

## 5. Corpus Analysis

In this section, we answer RQ1 (can humans predict appraisals from text?) and RQ3 (do annotators' properties play a role in their agreement?) with a quantitative discussion, and we address RQ2 qualitatively (how do appraisal judgments relate to textual realizations of events?). Because crowd-enVENT contains annotations from two different perspectives, we describe each of them separately and in comparison to one another.

Section 5.1 provides general descriptive statistics about the generation side of the corpus, including patterns across variables and their correspondence to the validation counterpart. Section 5.2 sharpens the focus on the relationship between appraisals and emotions in the generation phase. We then compare such a relationship to the readers' perspective (partially addressing RQ1). Section 5.3 narrows down to inter-annotator agreement computed both on the raw data (RQ1) and subsampling annotations conditioned on the annotators' properties (for RQ3). Lastly, in Section 5.4, we inspect instances in which the validators were either particularly successful or unsuccessful in recovering the writers' emotions and/or appraisals (RQ2). This qualitative analysis sheds light on some patterns of judgments that will be later investigated also in the automatic predictions.

### 5.1 Text Corpus Descriptive Statistics

Table 3 illustrates features of the generation side in crowd-enVENT. The corpus contains 6,600 texts, 550 per emotion, except for *guilt* and *shame*, having 275 items each. A text

**Table 3**

Data statistics of the generated data (phase 1). #T: number of texts,  $\overline{\#s}/\overline{\#t}$ : average number of sentences/tokens, s: seconds, m: minutes, h: hours, d: days, w: weeks, I: intensity.

| Emotion        |       |                  |                  | Event duration |       |       |      |      | Emotion duration |      |       |       |       | I   |
|----------------|-------|------------------|------------------|----------------|-------|-------|------|------|------------------|------|-------|-------|-------|-----|
|                | #T    | $\overline{\#s}$ | $\overline{\#t}$ | s              | m     | h     | d    | w    | s                | m    | h     | d     | w     |     |
| Anger          | 550   | 1.3              | 21.8             | 69             | 202   | 107   | 68   | 104  | 16               | 108  | 142   | 114   | 170   | 4.2 |
| Boredom        | 550   | 1.4              | 20.4             | 3              | 105   | 306   | 48   | 88   | 6                | 123  | 297   | 53    | 71    | 3.6 |
| Disgust        | 550   | 1.4              | 20.6             | 145            | 238   | 58    | 44   | 65   | 30               | 154  | 133   | 97    | 136   | 4.1 |
| Fear           | 550   | 1.4              | 22.4             | 97             | 233   | 105   | 46   | 69   | 16               | 142  | 143   | 112   | 137   | 4.5 |
| Guilt          | 275   | 1.3              | 21.9             | 45             | 92    | 62    | 28   | 48   | 9                | 34   | 55    | 58    | 119   | 4.0 |
| Joy            | 550   | 1.3              | 19.4             | 61             | 156   | 189   | 65   | 79   | 7                | 57   | 150   | 150   | 186   | 4.3 |
| No emo.        | 550   | 1.3              | 17.2             | 73             | 256   | 125   | 42   | 54   | 66               | 106  | 65    | 22    | 13    | 2.1 |
| Pride          | 550   | 1.3              | 19.0             | 67             | 186   | 137   | 49   | 11   | 11               | 54   | 134   | 171   | 180   | 4.2 |
| Relief         | 550   | 1.4              | 21.7             | 78             | 175   | 140   | 74   | 83   | 32               | 101  | 155   | 121   | 141   | 4.3 |
| Sadness        | 550   | 1.4              | 20.7             | 55             | 142   | 111   | 85   | 157  | 7                | 27   | 76    | 112   | 328   | 4.5 |
| Shame          | 275   | 1.3              | 20.6             | 37             | 114   | 59    | 24   | 41   | 1                | 32   | 65    | 74    | 103   | 4.1 |
| Surprise       | 550   | 1.2              | 18.4             | 110            | 235   | 97    | 51   | 57   | 29               | 107  | 153   | 129   | 132   | 4.1 |
| Trust          | 550   | 1.3              | 22.4             | 35             | 203   | 153   | 61   | 98   | 15               | 93   | 136   | 93    | 213   | 4.0 |
| $\Sigma$ /Avg. | 6,600 | 1.3              | 20.4             | 67.3           | 179.8 | 126.8 | 52.7 | 81.1 | 18.8             | 87.5 | 131.1 | 100.5 | 148.4 | 4.0 |

consists of one or more sentences. As shown in column  $\overline{\#s}$ , the average number of sentences is similar across emotions. Texts are also consistent in terms of length (see  $\overline{\#t}$ ). They comprise 20.43 tokens on average, with *fear* and *trust* receiving the longest descriptions (avg. 22.36) and *surprise* the shortest (avg. 18.38). Non-emotional expressions have fewer words overall, indicating that annotators provided less context to communicate non-affective content. In total, the corpus encompasses 134,851 tokens, excluding punctuation.<sup>14</sup>

Most texts describe events that took place within minutes or hours (“event duration” in Table 3). By contrast, *sadness* has an outstandingly high number of week-long events, and *surprise* and *fear* are characterized by a substantial amount of events that lasted only a few seconds. Interestingly, many texts report on emotions that persisted over days or weeks (“emotion duration”). This collides with the view that emotions are short-lived episodes (Scherer 2005), but it is unsurprising in our annotation setup. The annotators might have recalled longer emotion episodes in greater detail, and therefore, they might have recounted those to focus on a vivid memory. They might also have perceived long-lasting emotional impacts as being of particular importance (i.e., as special circumstances fitting one of our text diversification strategies).

It is reasonable to assume that another criterion by which they picked an episode from their past was the emotion intensity connected to it (column “I” in the table): For all labels but *boredom* and *no emotion*, the reported intensity is high. This also translates into high scores of confidence in the generation phase. Generally, the participants trusted their memory about the events they described, with average self-assigned confidence above 4.4 across all emotions. The confidence of readers about their own performance is lower, ranging between 3.4 for the *no emotion* instances and 4.1 for *joy*, with an average of 3.9.

Besides confidence, we have a number of other annotation layers that are not reported in the table. One of them is the emotional state prior to participation in our study. The values for this variable are by and large uniformly distributed within each prompting category. However, they differ across emotion categories: The highest average value is held by current states of *boredom* (2.24) followed by *joy* (2.06), *trust* (1.95), and *relief* (1.69). The lowest value is observed for *disgust* (1.17). Results are similar for the validation phase. Concerning personality traits, the participants reported high scores of *Conscientiousness* (avg. 2.32/2.60 in the generation/validation phases) and *Openness* (2.24/1.97).

The majority of people who disclosed their gender were female (generation: 1,639, validation: 710), followed by male (690, 480), and a handful identifying with gender variants (43, 22). Their age distribution has a median of 28 at generation time and 36 in the validation step. Most participants had a high school–equivalent degree (generation: 738, validation: 356), an undergraduate degree (975, 527), or a graduate degree (379, 223), and only a few did not have any formal qualification (9, 5). Moreover, most people identified as European (1,247, 808) or North American (550, 178).

For an overview of the semantic content of the corpus, we show the most frequent noun lemmata<sup>15</sup> as a proxy of the described topics in Table 4. Besides reoccurring terms (e.g., family- and work-related ones), which are used to contextualize the events themselves, some words are more specific to certain emotions, and they indicate concepts

<sup>14</sup> Tokenization via *nltk*, <https://www.nltk.org>.

<sup>15</sup> Calculated via *SpaCy* v.3.2, <https://spacy.io/api/lemmatizer>.

**Table 4**  
Most frequent nouns in each emotion category, sorted by frequency.

| Emotion  | Most frequent nouns  |
|----------|--|
| Anger    | work friend time partner car people child year day job husband family boyfriend son member school mother colleague week house daughter thing person ex         |
| Boredom  | work time hour day home job friend class room night meeting game week one thing house training task phone flight tv school lecture weekend traffic lot         |
| Disgust  | friend people man food dog work time child family day house person partner colleague car floor boyfriend street room parent job school night member cat        |
| Fear     | car night time friend day house dog year child work hospital road man people accident family dad spider son partner front job hour door way phone park life    |
| Guilt    | friend time child work money partner girlfriend day thing family brother school mother son sister relationship daughter year dog ex dad parent lot kid father  |
| Joy      | time friend year day child family boyfriend son job dog partner birthday birth baby work school life daughter car week room month wife song sister holiday     |
| No emo.  | morning job time work day friend boyfriend year school car thing grocery today event life situation shop tv task shopping people partner family college        |
| Pride    | work job year son time school daughter university friend day degree award team lot week child game student class college exam family company result            |
| Relief   | time day work job test house year week friend daughter result car surgery school month dog exam cancer university partner money home health son night          |
| Sadness  | friend year time family job dog dad day week child month boyfriend sister mum life parent daughter cat work husband school house home thing people             |
| Shame    | friend work school money day time parent front family test thing people sister member exam situation sex lot dad class child year wife store partner job       |
| Surprise | friend birthday year time job party boyfriend work sister partner gift car wife week parent girlfriend month money day trip person husband house college       |
| Trust    | friend partner time boyfriend husband work life secret family car relationship people job doctor day girlfriend situation hospital colleague money year person |

that have a prototypical emotion meaning in the collective imagination, like “spider” and “night” for *fear*, “birthday” for *surprise*, “degree” and “award” for *pride*.

## 5.2 Relation between Appraisals and Emotions

Moving on to our core annotation analysis, we investigate the relationship between appraisal and emotion variables. We start by focusing on the generation phase: Figure 8 shows the distribution of appraisals across emotions as it emerges from the judgments of the writers. Each cell reports the value of an appraisal dimension (on the columns) averaged across all descriptions prompted by a given emotion (on the rows). High numbers indicate that the appraisal and emotion in question are strongly related. Low values tell us that the appraisal hardly holds for that affective experience.

These results are not only intuitively reasonable but also in line with past studies in psychology (cf. Smith and Ellsworth 1985). We see, for instance, that events bearing

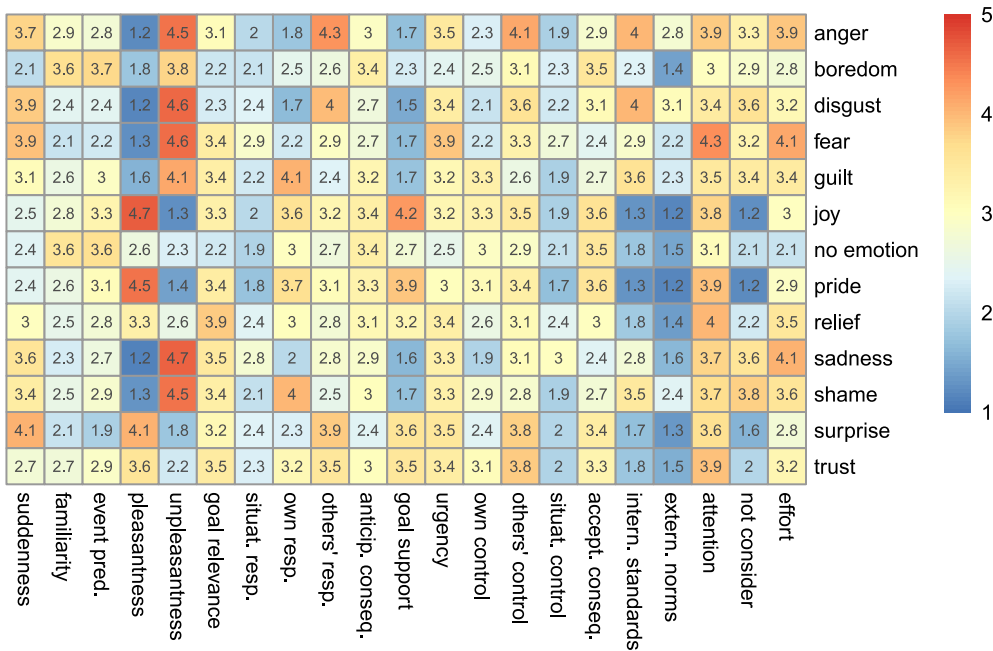
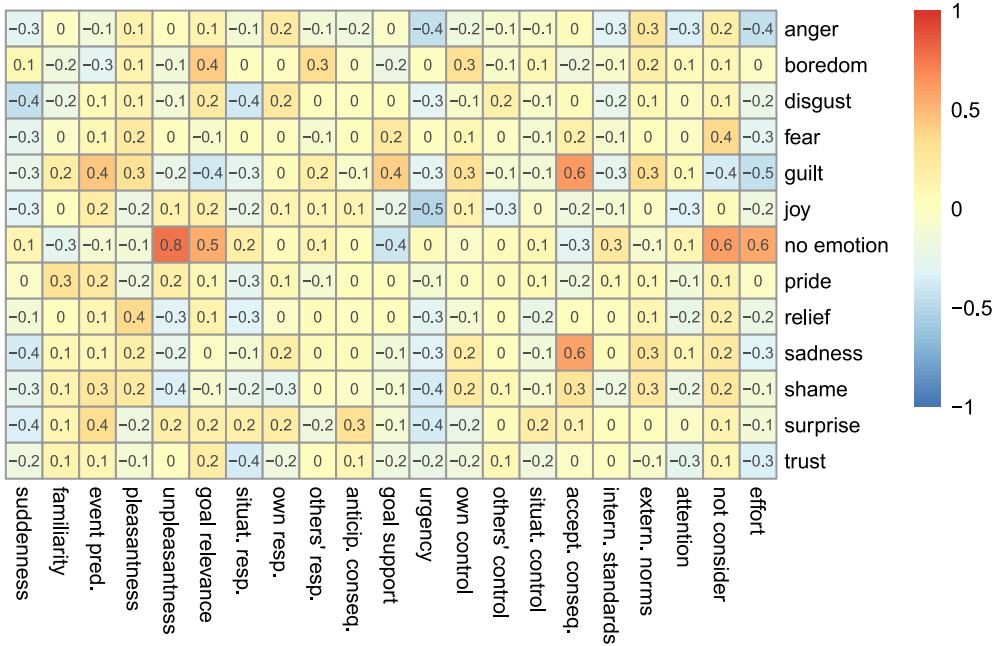


Figure 8

Average appraisal values as found among the writers' judgments, divided by emotion. Numbers range between 1 (dark blue) and 5 (dark red).

a high degree of *suddenness* are related to *surprise*, *disgust*, *fear*, and *anger* more than to other emotions. *Familiarity*, instead, commonly holds for events associated with *no emotion* and *boredom*. Another dimension that stands out for these two labels is *event predictability*: Its values are comparable to *familiarity* across all emotions, except for *surprise* and *anger*, where it is lower. As expected, *pleasantness* and *unpleasantness* are high for positive emotions (i.e., *joy*, *pride*, *trust*) and negative ones (e.g., *sadness*, *shame*), respectively. Among the positive categories, *trust* has the highest *unpleasantness* value. Also *internal standards* and *external norms* discriminate positive from negative classes, with some within-emotion differences (events sparking negative emotions, e.g., *disgust*, are deemed to violate self-principles more than social norms).

Next, *boredom* and *disgust* are associated with low values for the *goal relevance* of events, while the combination of the three responsibility-oriented appraisals distinguishes a set of emotions: *anger*, *disgust*, and *surprise* stem from events initiated by others (*other responsibility* > *situational responsibility* > *own responsibility*), *guilt* and *shame* are attributed to the self (*own responsibility* > *other responsibility* > *situational responsibility*), and so are *joy* and *pride*, although to a lower degree. Once more, *trust* differs from the other positive emotions, as it accompanies events triggered by other individuals or by the experiencers themselves (e.g., lending someone a precious object) but not by chance. It is interesting to compare the responsibility-specific annotations of *guilt* and *shame* to the three dimensions focused on one's ability to influence events. Also, the writers felt that the development of the facts was in their *own control* more than in the hands of external factors (*others' control*/*situational control*). Among the two, however, *own control* is especially related to *guilt*, an emotion stemming from behaviors that can be regulated



**Figure 9** Comparison between the average appraisal values assigned by the generators and the validators, divided by emotion. Cells (in the red spectrum) indicate that the generators on average picked higher scores; and vice versa for cells with negative numbers (in blue). Zero values indicate a perfect match between the average scores of the two phases.

rather than from stable traits of the experiencer (which contribute instead to episodes of *shame* [Tracy and Robins 2006]). The *anticipation of consequences* reaches particularly low values for *surprise*, *disgust*, and *fear*, with the latter being characterized by the strongest level of *effort* (together with *sadness*) and of *attention*, as opposed to *shame*, *disgust*, and *sadness*, for which the texts’ authors reported their attempt to dismiss the event.

While these numbers provide a picture of the cognitive dimensions underlying emotions, they do not answer RQ1 in itself. For that, we inspect the same information by including the validation side of crowd-enVENT. We compare the two batches of judgments in Figure 9. To create this heatmap, we calculate the average appraisal values across the prompting emotions—like in Figure 8, but using the validators’ appraisal answers and the 1,200 corresponding generators’ answers, separately; then, we subtract the results of the former from the latter. Therefore, a cell here shows the difference between the average gold standards given by the experiencers and the readers’ assessments. Should the validators’ appraisals be similar to those of the people who lived through the events (thus approaching 0 throughout Figure 9), we could conclude that it is possible to obtain corpora with reliable appraisal labels via traditional annotation methods, based on external judges who determine the affective import of existing texts.

The figure illustrates some interesting patterns: Divergent ratings stand out for *unpleasantness*, *goal relevance*, *not consider*, and *effort* in the row *no emotion*, as well as for *urgency* in *joy*, *effort* in *guilt*, and the *accept. conseq.* in both *guilt* and *sadness*. *Suddenness*, *effort*, and *urgency* have lower values across all emotions, while for *event predictability*,

*external norms*, and *not consider*, the validators tended to choose ratings that surpassed the original ones.

Overall, these differences are comparably low (all absolute values are below 1). We conclude that readers of event descriptions successfully reconstruct appraisal dimensions. We now move to a more detailed analysis of agreements.

### 5.3 Conditions of Inter-Annotator Agreement

We discuss inter-annotator agreement based on a comparison between generators and validators (for RQ1) and among the validators. Further, we scrutinize if their agreement is influenced by some of their personal characteristics (for RQ3), to understand if there is a tendency to agree more if the judges share specific properties. The datapoints that we consider are extracted from crowd-enVENT as follows. First, we take all study participants who generated/validated the same texts and pair them. In total we obtain 6,600 generator–validator (G–V) pairs (each generator is coupled with 5 validators) and 12,000 validator–validator (V–V) pairs ( $\binom{5}{2} \cdot 1,200$ ). We then filter the G–V and V–V pairs according to various properties (e.g., the age difference between both members of a pair) that either characterize them or not. This leads to various subsets of annotated texts (e.g., the subset of texts in which the age difference of the paired judges is higher than a particular threshold, and the subset where it is lower). We only consider the intersection of these text subsets, i.e., that have been annotated by pairs of all properties under analysis for one variable.

The properties in question are those collected during corpus construction, corresponding to the rows in Table 5. For gender, annotators can be both male, both female, or each a different gender; for age, we focus on age differences, as greater or lower than 7 years. Familiarity with the event concerns the validators only. The generators know the event by definition; hence, only one member of G–V could be unfamiliar with it, while familiarity can hold or not hold for both annotators in V–V. Lastly, we take into account personality traits because past research found that people with particular traits are better at recognizing emotions from facial expressions (cf. Section 3). We investigate if a similar phenomenon happens in text, and filter the pairs like so: Did the validator(s) turn out to be open, conscientious, extraverted, agreeable, or emotionally stable?

From all of these data subsets, we compute agreement through multiple measures. For emotions, we use average  $F_1$  and accuracy, for appraisal annotations, we use average RMSE scores. We do not normalize for expected agreement, as it is commonly done with  $\kappa$  measures, because we do not have unique annotators that remain stable over a considerable amount of texts—which prevents us from assigning a meaningful value for the expected agreement with each individual.

Table 5 summarizes the results. Note that the number of pairs varies depending on the property under consideration, as different properties might hold for different numbers of people. Boxes indicate that the results have been obtained from the same textual instances. We can therefore compare numbers inside the same box, but not across boxes (either because they refer to different evaluation methods or different concepts, or because they were calculated on different textual instances). We calculate the significance under a .95 confidence level via bootstrap resampling (1,000 samples) on the textual instances for each evaluation measure, pairwise for all results inside each box (Canty and Ripley 2021; Davison and Hinkley 1997). Pairs of asterisks indicate pairs of numbers that are significantly different (all of them are, if three values are marked with an asterisk).

**Table 5**

Conditions of reconstruction agreement. Emotion agreement is shown as F1 and Acc. between pairs of labels from a generator and a validator (G–V) or two validators (V–V). The appraisal agreement is an average root mean square error. #Pairs denotes the number of G–V (1st) or V–V (2nd) pairs for each condition. Boxes indicate measure values computed on the same textual instances, which can therefore be directly compared. \* indicates all pairs that are significantly different from each other inside a box; calculated with  $1,000 \times$  bootstrap resampling, confidence level .95.

| Condition                 | Val. | #Pairs |        | Agreement      |      |      |      |           |       |      |  |
|---------------------------|------|--------|--------|----------------|------|------|------|-----------|-------|------|--|
|                           |      |        |        | Emotion        |      |      |      | Appraisal |       |      |  |
|                           |      |        |        | F <sub>1</sub> |      | Acc. |      | RMSE      |       | RMSE |  |
| G–V                       | V–V  | G–V    | V–V    | G–V            | V–V  | G–V  | V–V  |           |       |      |  |
| All Data                  |      | 6,600  | 12,000 | .49            | .49  | *.50 | *.52 | *1.57     | *1.48 |      |  |
| Gender match              | M–M  | 631    | 1,113  | .50            | *.45 | .51  | *.49 | 1.55      | 1.50  |      |  |
|                           | F–F  | 2,405  | 1,377  | .49            | *.52 | .51  | *.55 | 1.57      | *1.50 |      |  |
|                           | ≠    | 2,962  | 3,920  | .49            | *.48 | .50  | *.52 | 1.57      | *1.48 |      |  |
| Age diff.                 | > 7  | 3,089  | 7,991  | .49            | *.48 | .51  | *.51 | *1.58     | 1.48  |      |  |
|                           | ≤ 7  | 2,076  | 3,939  | .49            | *.51 | .50  | *.54 | *1.56     | 1.48  |      |  |
| Validators' event fam.    | > 3  | 1,386  | 540    | .49            | .44  | .51  | .47  | *1.60     | *1.42 |      |  |
|                           | ≤ 3  | 2,099  | 676    | .48            | .45  | .49  | .48  | *1.58     | *1.47 |      |  |
| Validators' openness      | +    | 2,685  | 1,472  | .49            | .49  | .50  | .52  | 1.57      | 1.47  |      |  |
|                           | –    | 3,000  | 1,568  | .49            | .48  | .50  | .51  | 1.57      | 1.48  |      |  |
| Validators' conscien.     | +    | 3,151  | 1,638  | *.48           | .51  | *.49 | .53  | *1.57     | *1.49 |      |  |
|                           | –    | 2,589  | 1,426  | *.50           | .51  | *.51 | .54  | *1.56     | *1.46 |      |  |
| Validators' extaversion   | +    | 2,878  | 1,685  | .49            | *.48 | .50  | *.51 | *1.58     | *1.51 |      |  |
|                           | –    | 2,812  | 1,535  | .50            | *.52 | .51  | *.55 | *1.56     | *1.46 |      |  |
| Validators' agreeableness | +    | 2,675  | 1,451  | .49            | *.51 | .51  | *.54 | *1.58     | 1.47  |      |  |
|                           | –    | 2,930  | 1,553  | .48            | *.45 | .49  | *.49 | *1.56     | 1.47  |      |  |
| Validators' emot. stab.   | +    | 2,838  | 3,009  | *.48           | *.48 | *.49 | *.51 | *1.57     | *1.50 |      |  |
|                           | –    | 2,792  | 2,897  | *.50           | *.51 | *.51 | *.54 | *1.56     | *1.46 |      |  |

The row “All Data” in the table contains all annotation pairs, not filtered by any property. In this row, G–V and V–V values can be compared. We see that the agreement on emotions of the V–V pairs is higher than that achieved by the G–V pairs, with a 2 percentage point (2pp) (significant) difference in accuracy (no difference in F<sub>1</sub>). We take this as a first sign of the validators’ reliability and correct interpretation of the guidelines: They agree with the point of view that they are attempting to reconstruct and with all other judges undertaking the same task. The significant accuracy difference between G–V and V–V pairs stems mostly from a mismatch between generators and validators on *joy/surprise* (prompting/validated emotion), *joy/pride*, *joy/relief*, *sadness/anger*, and *no emotion/boredom*. We will analyze these cases in more detail later on. The difference in agreement for the annotation of appraisals is also significant, and more noticeable (1.57 for G–V vs. 1.48 for V–V). The biggest difference holds for *not consider*, followed by *other responsibility* and *situational responsibility*. There is no appraisal dimension in which G–V pairs outperform V–V pairs.

In all other rows results obtained from annotator pairs are filtered by property. For the gender matches, we tackle the groups with the most common self-reported answers (i.e., male, female). Note that the numbers under G–V and V–V do not come from the same texts (in our data, being male and female are mutually exclusive properties<sup>16</sup>). For emotions, mixed-gender pairs disagree significantly more than the female subsets. This is also the case for male pairs, with a 7pp difference in  $F_1$ . Mostly, female participants agree more on what is considered to cause *shame* and *guilt*, where male participants tend to disagree.

To evaluate the impact of age on agreement, we separate the pairs at a threshold of 7 years (we tested other thresholds, which lead to smaller differences). Interestingly, all differences are comparably small (<3pp in  $F_1$  and Acc.), but still significant for emotions among V–V pairs and for appraisals among G–V pairs.

The property of event familiarity (self-assessed on a 1–5 scale) leads to a significant difference in the appraisal assessments. Interestingly, *non*-familiar validators tend to agree more with generators and each other than those that indicated being familiar with an event. A possible explanation is that readers who did not experience an event similar to the description rely purely on the information emerging from the text and are not biased from their own experiences.

For the analysis of the influence of validators' personality traits, we split the validators with a threshold that approximates a balanced separation of all judges. The trait of *Openness* does not show any significant relation to agreement across all measures and annotation variables. The traits of *Conscientiousness* and *Introversion* show a small but significant positive impact on the agreement measures. Validators that indicated being *Agreeable* show significant and considerably higher agreement with each other in the emotion labeling task. A lack of *Emotional Stability* corresponds to a small but significant improvement in agreement across both emotions and appraisals and G–V/V–V pairs.

We did not find any substantial difference between the general agreement and the agreement between groups of the same ethnicity or education.

In summary, the analysis of inter-annotator agreement conditioned on self-reported personal information revealed that better emotion and appraisal reconstructions are favored by specific properties. However, differences between groups of judges with diverse properties are small, and the within-validation phase agreement compares to that between generators and validators, considering agreement on all data irrespective of group filterings. Hence, we conclude that *the annotations provided by the readers are reliable*.

## 5.4 Qualitative Discussion of Differences

A manual inspection of the data deepens our understanding of inter-annotator agreement. We investigate the texts on which judges (dis)agree and divide them into two categories, namely, those that turned out “easy” to label and those where the correct inference is difficult to draw. Table 6 shows examples in which all readers correctly reconstructed the writers' emotion. Table 7 reports items where all validators inferred the same emotion, but that emotion does not correspond to the gold label—as revealed in the quantitative discussion, agreeing on the emotion does not imply agreeing on the appraisals. We report this observation by dividing the tables in two blocks. The top

16 For a text, e.g., M–M might be among the validator pairs, but not in the generator-validator ones in case the generator is female.

**Table 6**

Examples where all validators (V) correctly reconstruct the emotion of the generators (G). The top (bottom) examples have high (low) agreement on appraisals.

| Id  | Emo.    |   | Appr. | Text  |
|-----|---------|---|-------|---|
|     | G       | V | RMSE  |   |
| 1   | pride   |   | 0.65  | I baked a delicious strawberry cobbler.   |
| 2   | fear    |   | 0.69  | I was running away from a shooting and a car was trying to run me down  |
| 3   | fear    |   | 0.72  | I felt ... when there was a power outage in my home. That day, my wife and I were cuddling in the sitting room when a thunderstorm started. Then ... filled me when thunder hit our roof and all the lights went off. |
| 4   | pride   |   | 0.82  | I felt ... when I ran a marathon at a decent pace and finished the race in a good place   |
| 5   | fear    |   | 0.84  | A housemate came at me with a knife.  |
| 6   | fear    |   | 0.86  | I was surrounded by four men; they hit me in the face before I offered to give them everything I had in my pockets.   |
| 7   | pride   |   | 0.89  | I felt ... when I accomplish my goals through a team effort. I take part in team sports and have a pivotal role in success, and being able to do my job and make my team proud of me gives me a strong sense of ...   |
| 203 | fear    |   | 1.68  | I felt ... when I was in a public place during the coronavirus pandemic   |
| 204 | pride   |   | 1.73  | I helped out a friend in need   |
| 205 | fear    |   | 1.74  | I felt ... when i had a night terror.   |
| 206 | boredom |   | 1.81  | I went on holiday abroad for the first time. I felt ... because I didn't enjoy being on the beach doing nothing.  |
| 207 | sadness |   | 1.86  | I felt ... when I graduated high school because I remember that I'm growing up and that means leaving people behind.  |
| 208 | disgust |   | 2.03  | His toenails where massive  |
| 209 | fear    |   | 2.08  | I felt ... going in to hospital   |
| 210 | trust   |   | 2.35  | my husband is always there for me and i can ... that no matter what he will be there for our child and do what ittakes to provide for us as a family  |

block corresponds to texts with high G–V agreement in appraisal (as an average RMSE), while the bottom to high disagreement.

The top examples in Table 6 describe events, varying from ordinary circumstances (e.g., baking) to peculiar ones (e.g., being threatened by a housemate) that have unambiguous implications for the well-being of the experiencer. It can be argued that these texts describe situations with shared underlying characteristics graspable even by people who did not experience them (e.g., most likely, being threatened spurs *unpleasantness*, *scarce goal relevance*, and *inability to anticip. conseq.*). By contrast, the examples with low agreement on appraisals seem to require a more elaborate empathetic interpretation. They might be easily understandable with regard to the emotion, but they underspecify many details about the described situation, which would be necessary for a reader to infer how it was evaluated along fine-grained dimensions. For instance, going to the hospital is attributed to fear, but it remains unclear under which circumstances this situation occurs (a planned surgery? an accident? to visit someone?).

Table 7 contains texts from which readers did not recover the actual emotion experienced by the author. Instances of high appraisal agreement are associated with labels with similar affective meanings, and are therefore more likely to be confused than, for instance, a positive and a negative emotion. Mislabeling occurs mostly between *joy* and

**Table 7**

Examples in which all validators (V) agree with each other, but not with the generators (G) of the event descriptions. The top (bottom) blocks shows texts where the agreement is high (low) on appraisals.

| Id | Emo.       |         | Appr. | Text   |
|----|------------|---------|-------|--|
|    | G          | V       | RMSE  |  |
| 1  | joy        | pride   | 0.81  | finally mastered a song i was practising on guitar   |
| 2  | pride      | joy     | 0.83  | my band got signed to a label run by an artist i admire  |
| 3  | trust      | joy     | 0.87  | I am with my friends   |
| 4  | joy        | pride   | 0.90  | I bought my own horse with my own money I had worked hard to afford  |
| 5  | surprise   | pride   | 0.93  | when I built my first computer   |
| 6  | surprise   | joy     | 1.00  | I felt ...when my partner put their arms around me at a concert and started to dance with me to a song we listen to.             |
| 7  | trust      | joy     | 1.01  | I felt ... when my boyfriend drove out of town to see me at 2 in the morning.  |
| 8  | anger      | fear    | 1.09  | My waters broke early during pregnancy   |
| 9  | joy        | pride   | 1.11  | I was able to complete a challenge that I didn't think I would do  |
| 43 | pride      | sadness | 1.65  | That I put together a funeral service for my Aunt  |
| 44 | surprise   | joy     | 1.66  | I got a dog for my birthday  |
| 45 | joy        | relief  | 1.68  | I was diagnosed with PMDD because it meant I had answers   |
| 46 | no emotion | anger   | 1.69  | I saw an ex-friend who stabbed me in the back with someone I considered a friend   |
| 47 | shame      | relief  | 1.81  | I tasked with sorting out some files from the office the previous day and I slept off when I got home                            |
| 48 | disgust    | sadness | 1.82  | I was left out of a family chat.   |
| 49 | sadness    | relief  | 1.83  | when I returned to my apartment after being away during COVID.   |
| 50 | shame      | sadness | 1.84  | Not being around my son  |
| 51 | surprise   | joy     | 1.90  | I found the perfect man for me, and the more time goes on, the more I realized he was the best person for me. Every day is a ... |
| 52 | no emotion | sadness | 1.93  | Breaking up with my partner  |

*pride*, both of which are (arguably) appropriate, and in one case between *anger* and *fear*. Instead, the bottom block of the table reports texts in which a positive emotion is misunderstood for a negative one. For instance, Id 43 was produced for *pride* but was validated as *sadness*. These mistakes might be due to the readers focusing on a portion of text different from that considered salient by the writer (e.g., Id 49, “being away with covid”: *sadness*, “returning home”: *relief*), or to the readers drawing a presupposition from the text (e.g., Id 43, a funeral took place: *sadness*) different from what the author intended to convey (he/she was able to organize it: *pride*). It is also possible that some of these G–V disagreements derive from the sequence of tasks in the survey. The readers were first prompted to assign an emotion to the event and only later were they guided to evaluate it in detail. Going the other way might have led the crowdworkers to reflect on the events in a more structured way, and might have elicited different judgments. There are also examples in which an emotion is assigned while none was felt by the event experiencer (e.g., Id 46 and 52). On the one hand, this is a sign of the subjectivity of emotions. On the other, it says something about how some writers tackled the

task: They likely decided to recount a circumstance that usually would not leave individuals in apathy but that, unexpectedly, turned out to not perturb their own general sense of feeling.

Brought together, these observations illustrate features of crowd-enVENT, and suggest some systematic patterns in its annotation that are informative about agreement. To begin with, part of the instances that we collected convey enough information for readers to understand emotions, independent of if and how they also understand the underlying evaluation. From this, we derive that *at least in some cases, grasping appraisals from text is not necessary to grasp the corresponding emotion*—which is an insight that we further explore in our modeling experiments, by using systems for emotion recognition that can decide to leverage or ignore appraisals information.

Second, by contrasting the high-vs.-low appraisal agreements blocks of Table 7, we learn that the “semantic difference” between emotions that are incorrectly reconstructed is lower if the appraisals are inferred acceptably well (e.g., readers picked *pride* instead of *joy*, while they face confusions between more incongruent labels, e.g., *pride/sadness*, by disagreeing also on the appraisals). Put differently, the annotators can share the underlying understanding of an affective experience, even if they disagree on a discrete label to name it. Hence, the labels they choose can be considered compatible alternatives. As our single-label experimental set-up did not request the description authors to indicate multiple emotion labels for their experience, a follow-up study would be needed to confirm this hypothesis.

Third, there are instances where humans fail to reconstruct emotions, and differences between such judgments are mirrored in differences in their appraisal measures. We hypothesize that the correct appraisal information can be valuable for improving the emotion classification of these instances—it might disambiguate alternatives by offering information that is not described in the text. In the modeling set-up, we explore this idea by looking at how an appraisal-aware emotion recognition model improves as it accesses evaluations-centered knowledge.

## 6. Modeling Appraisals and Emotions in Text


In the preceding section, we answered RQ1 from an annotators-based perspective (Is there enough information in a text for humans to predict appraisals?). We answer the same question here, but by turning to a computational modeling discussion: Is there enough information in a text for classifiers to predict appraisals? Our ultimate goal is to understand if these psychological models are not only usable but also advantageous for emotion analysis. Therefore, we also address RQ4: Do appraisals practically enhance emotion predictions?

We formalize different models and motivate the relationship between them. Next, we put them to use to predict emotion categories and appraisal dimensions. Such models consist of three main classes that vary with respect to their input, output, and sequence of steps. We have: models that take text as their only input and that output either an emotion category ( $T \rightarrow E$ ) or appraisal dimensions ( $T \rightarrow A$ ); models that use only appraisal patterns as input to predict emotions ( $A \rightarrow E$ ); and emotion predictors with mixed input, informed by both text and appraisals ( $TA \rightarrow E$ ).

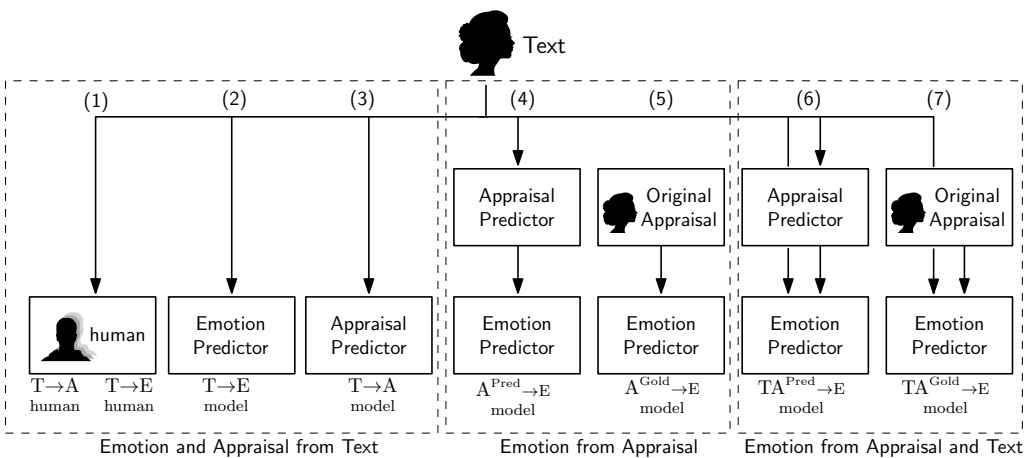
As explained below, each model mirrors a precise view on the emotion component process theory. By evaluating their predictions against the ground truth labels, we can validate the underpinning theory from a text classification perspective. For instance, if emotions arise deterministically from the 21 dimensions that we study, our appraisal-to-emotion classifiers ( $A \rightarrow E$ ) should work acceptably well. Moreover, if the information

concentrated in the event description is enough to reconstruct appraisals, then  $T \rightarrow A$  should show a good performance, and the consequent step from there to emotions ( $A \rightarrow E$ ) should be straightforward.

### 6.1 Model Architecture and Experimental Set-up

Figure 10 illustrates our experimental framework. In total, we consider 7 models. A box in the depiction indicates a model (the head  indicates data that directly stems from the generator of a textual instance). The lines correspond to the flow of information used by the box connected with an arrowhead. The left-most model (denoted as (1) in the depiction) is not a computational system, but represents the classification performance of the validators of crowd-enVENT. We include that in order to understand how well people performed in the task undertaken by our machine learning-based systems (indicated by the numbers from (2) to (7)). Specifically, we focus on how the readers predicted the prompting emotions and the correct appraisals from text, treating these two “human models” separately (i.e.,  $T \rightarrow E_{\text{human}}$  and  $T \rightarrow A_{\text{human}}$ ). Under the assumption that humans outperform computational models, (1) will act as an upper bound for the automatic classifiers.

We use (2) as a baseline computational model to predict emotion categories for a given text ( $T \rightarrow E_{\text{model}}$ ), learning the task in an end-to-end fashion. From a psychological perspective, this classifier aligns with theories of basic emotions discussed in Section 2.2, as it is purely guided by the definition of the output categories—although only a subset of our 11 emotion labels would be considered “basic” in the strict definition of Ekman (1992). The model in (3) is set up analogously, but it predicts a vector of appraisal values. This  $T \rightarrow A_{\text{model}}$  can be considered in line with a constitutive theoretical approach (as described by Smith and Ellsworth [1985] or Clore and Ortony [2013]) where the appraisal variables instantiated in response to an event represent the emotion itself—hence, they do not serve as input to predict a consequent discrete emotion label. Even without such an additional step, this model can be practically useful, similar to emotion analysis systems that output scores of valence or arousal.



**Figure 10** Models to predict emotions and appraisals and to understand interactions among tasks.

We further use (3) in the pipeline represented in (4), which performs the additional appraisal-to-emotion step. There, the emotion predictor is trained on the appraisal-based output of (3). To evaluate this  $A^{\text{Pred}} \rightarrow E_{\text{model}}$ , we compare it against  $A^{\text{Gold}} \rightarrow E_{\text{model}}$  (5), which is required to accomplish the same emotion prediction task, but is trained on the writers' original appraisal judgments.

Lastly, we instantiate two combined models,  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$  (6) and  $TA^{\text{Gold}} \rightarrow E_{\text{model}}$  (7), which have access to both the texts and the corresponding appraisals. These consist of the predictions of  $T \rightarrow A_{\text{model}}$  for  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ , and of the judgments provided by the event experiencers for  $TA^{\text{Gold}} \rightarrow E_{\text{model}}$ . Being pipelines, all models from (4) to (7) have a structural affinity to the evaluative tradition of emotion theories (Section 2) that involves a deterministic perspective on emotions: The appraisals of an event cause the emotion experience (Scherer, Schorr, and Johnstone 2001b; Scherer and Fontaine 2013). However, as opposed to (4) and (5), models (6) and (7) do not follow a strict pipeline architecture, as they can decide to bypass the appraisal information, if not needed for the emotion prediction.

To bring all these models together into an evaluation agenda, we conduct three experiments.

**Experiment 1:** We use  $T \rightarrow A_{\text{model}}$  and  $T \rightarrow A_{\text{human}}$ . The human model enables us to assess the task's difficulty. It informs us about what we can reasonably expect from the systems. Therefore, we use it as a benchmark to evaluate  $T \rightarrow A_{\text{model}}$  and consequently answer RQ1.

**Experiment 2:** Before assessing if appraisals are beneficial for the prediction of emotions from text (RQ4), we need to verify if emotions can be inferred from such 21 appraisal dimensions. According to psychology, humans do the appraisal-to-emotion mapping in real life. Here we investigate if that is the case also for machine learning-based models ( $A^{\text{Gold}} \rightarrow E_{\text{model}} / A^{\text{Pred}} \rightarrow E_{\text{model}}$ ).

**Experiment 3:** We use  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ ,  $TA^{\text{Gold}} \rightarrow E_{\text{model}}$ ,  $T \rightarrow E_{\text{model}}$ , and  $T \rightarrow E_{\text{human}}$ . We investigate if the appraisal-informed models have any advantage over the latter two, which are only based on text. Hence, we answer RQ4.

Because each of the 1,200 validation instances was evaluated by 5 different annotators, we aggregate all judgments (instance by instance) into a final, adjudicated label, thus obtaining the same level of granularity that we have for the automatic predictions. We use the majority vote for the aggregation of both emotions and appraisals. We do not opt for averaging the appraisal judgments as this would flatten the annotation of the various dimensions and not account for differences in their reconstruction. Whenever the majority vote leads to a tie, we resolve it by assigning a higher weight to the appraisal judgments of annotators who self-assigned a strong degree of confidence.

For all computational models, we use the same 1,200 instances that have been validated by the human annotators as a test set. We randomly split the remaining 5,400 generation instances into training and validation data (90% for training, i.e., 4,860 instances; 10% for validation, i.e., 540 instances) without strictly enforcing stratification by prompting emotion label.

The emotion predictors are classification models that choose one single label from the set of prompting emotions. The appraisal models are instantiated twice: as regressors that predict a continuous value in  $[0:1]$ , and as classifiers in a discretized variant of the problem. For that, we map the 5-point scales of the appraisal ratings to 0,

corresponding to  $\{1,2,3\}$  in the original answer, and 1, if the original answer was  $\{4,5\}$ .<sup>17</sup> Approaching this problem in a classification set-up allows us to compare our results to previous work (Hofmann et al. 2020), and see if the systems agree with humans at least about an appraisal holding or not (more than recognizing its fine-grained value).

Our implementation builds on top of Huggingface Transformers (Wolf et al. 2020). All experiments take the pretrained RoBERTa-large model (Zhuang et al. 2021) as a backbone, implemented in the AllenNLP library (Gardner et al. 2018). Depending on the task, we use a classification or regression layer on top of the average-pooled output representations. The training objective is to minimize the cross-entropy loss for all text-based classifiers, and the mean square error loss (MSE) for all regressors. We report the mean of the results across 5 runs and use validation data to perform early stopping. The learning rate is  $3 \cdot 10^{-5}$ , the maximal number of epochs is 10, and the batch size is 16.

For  $A^{\text{Gold}} \rightarrow E_{\text{model}}$  and  $A^{\text{Pred}} \rightarrow E_{\text{model}}$ , we use a single-layer neural network with 64 hidden nodes, ReLU (Nair and Hinton 2010) activation, and a dropout rate (Srivastava et al. 2014) of 0.1 between the hidden and input layer. The training objective is to minimize the cross-entropy loss. For  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$  and  $TA^{\text{Gold}} \rightarrow E_{\text{model}}$ , we concatenate the vector of appraisal values to the pooled vector representation of the textual instance before the output layer.

## 6.2 Results

We analyze the modeling results with traditional evaluation metrics for text classification, namely, macro-averaged precision, recall, and macro- $F_1$ . The appraisal regressors are evaluated via RMSE. All reported scores are averages across 5 runs with different seeds. Standard deviations are in Appendix, Table 17 (for Experiment 1), Table 18 (for Experiment 2), and Table 19 (for Experiment 3).<sup>18</sup>

*6.2.1 Experiment 1: Reconstruction of Appraisal from Event Descriptions.* Table 8 illustrates the outcome of appraisal reconstruction from text, carried out computationally and by the validators. Both the automatic classifier and the regressor have an acceptable performance, with a .75 macro-average  $F_1$  and an averaged  $\text{RMSE} = 1.40$ .

Focusing on the classification task, the dimensions of *external norms*, *pleasantness*, and *situational control* correspond to better quality outputs, especially compared with *urgency*, *others' control*, and *accept. conseq.* where  $F_1$  is the lowest. Dimensions that are easy/hard to reconstruct from a computational perspective are so also for the validators. Overall, however, the computational model achieves higher results than human validators. As we see in the column  $\Delta_{F_1}$ , which reports the differences between  $T \rightarrow A_{\text{model}}$  and  $T \rightarrow A_{\text{human}}$ , classification models show 13pp higher  $F_1$ .

The same trend emerges from the regression framework, where the average error drops by 6 points. The improvement is not equally distributed across appraisals. It stands out on the dimensions of *external norms*, *urgency*, *others' control*, *situational control*, and *suddenness*. In many of these variables with a  $\Delta_{\text{RMSE}} < .10$ , the original ratings are spread more uniformly across the 5-point answer scale (cf. *others' control*, *suddenness*,

17 The decision on this threshold derives from the distribution analysis shown in Figure 13 in the Appendix.

18 Note that the evaluation of the human-based models leads to different  $F_1$  values than those in the corpus analysis section, where we considered multiple pairs of human-generated labels for each text—here, we have aggregated judgments. The individual predictions for all models are part of the supplementary material.

**Table 8**

Appraisal prediction performance of human validators ( $T \rightarrow A_{\text{human}}$ ) and computational models ( $T \rightarrow A_{\text{model}}$ ). For the classification set-up, we report Precision, Recall, and  $F_1$ . For the regression set-up, we report the root mean square error (RMSE).  $\Delta$ : difference between  $T \rightarrow A_{\text{model}}$  and  $T \rightarrow A_{\text{human}}$ . Standard deviations are reported in Table 17 in the Appendix.

| Appraisal          | Classification |     |       |           |     |       |                | Regression |           |                        |
|--------------------|----------------|-----|-------|-----------|-----|-------|----------------|------------|-----------|------------------------|
|                    | T→A human      |     |       | T→A model |     |       | $\Delta_{F_1}$ | T→A human  | T→A model | $\Delta_{\text{RMSE}}$ |
|                    | P              | R   | $F_1$ | P         | R   | $F_1$ |                | RMSE       | RMSE      |                        |
| Suddenness         | .75            | .61 | .68   | .70       | .79 | .74   | +06            | 1.47       | 1.33      | -.14                   |
| Familiarity        | .66            | .45 | .53   | .77       | .82 | .79   | +26            | 1.49       | 1.42      | -.07                   |
| Event Predict.     | .60            | .54 | .56   | .76       | .74 | .75   | +19            | 1.46       | 1.47      | +.01                   |
| Pleasantness       | .82            | .84 | .83   | .88       | .87 | .88   | +05            | 1.10       | 1.30      | +.20                   |
| Unpleasantness     | .85            | .84 | .85   | .79       | .80 | .80   | -.05           | 1.22       | 1.26      | +.04                   |
| Goal Relevance     | .65            | .67 | .66   | .73       | .69 | .71   | +05            | 1.52       | 1.57      | +.05                   |
| Situat. Resp.      | .70            | .37 | .48   | .83       | .87 | .85   | +37            | 1.55       | 1.43      | -.12                   |
| Own Resp.          | .75            | .71 | .73   | .81       | .77 | .79   | +06            | 1.32       | 1.40      | +.08                   |
| Others' Resp.      | .75            | .74 | .74   | .74       | .72 | .73   | -.01           | 1.54       | 1.57      | +.03                   |
| Anticip. Conseq.   | .57            | .48 | .52   | .67       | .71 | .69   | +17            | 1.61       | 1.50      | -.11                   |
| Goal Support       | .74            | .62 | .67   | .80       | .82 | .81   | +14            | 1.36       | 1.33      | -.03                   |
| Urgency            | .66            | .46 | .54   | .63       | .60 | .61   | +07            | 1.68       | 1.43      | -.25                   |
| Own Control        | .57            | .48 | .53   | .78       | .81 | .79   | +26            | 1.48       | 1.35      | -.13                   |
| Others' Control    | .76            | .76 | .76   | .64       | .60 | .62   | -.14           | 1.55       | 1.36      | -.19                   |
| Situat. Control    | .71            | .40 | .51   | .84       | .90 | .87   | +36            | 1.53       | 1.35      | -.18                   |
| Accept. Conseq.    | .48            | .39 | .43   | .63       | .65 | .64   | +21            | 1.44       | 1.36      | -.08                   |
| Internal Standards | .68            | .51 | .57   | .82       | .83 | .82   | +25            | 1.16       | 1.34      | +.18                   |
| External Norms     | .63            | .52 | .56   | .90       | .95 | .92   | +36            | 1.77       | 1.44      | -.33                   |
| Attention          | .74            | .75 | .74   | .50       | .48 | .48   | -.26           | 1.38       | 1.27      | -.11                   |
| Not Consider       | .55            | .53 | .54   | .83       | .71 | .77   | +23            | 1.56       | 1.53      | -.03                   |
| Effort             | .70            | .54 | .61   | .69       | .70 | .70   | +09            | 1.47       | 1.38      | -.09                   |
| Macro avg.         | .68            | .58 | .62   | .75       | .75 | .75   | +13            | 1.46       | 1.40      | -.06                   |

*anticip. conseq.* in Figure 13, Appendix). This suggests that the regression task on appraisals might be easier for dimensions that take on a varied range of values in the training data. By contrast, in the classification set-up, the gap between automatic and human performances characterize dimensions whose original judgments concentrate on either end of the rating spectrum, like *external norms*, *situational control*, *situational responsibility*, *internal standards*, *own control*, and *familiarity*, all surpassing the judges by more than 20pp.

Hence, both the classifier and the regressor outdo  $T \rightarrow A_{\text{human}}$ , that we hypothesized to represent an upper bound for their performance. They grasp some information about the writers' perspective that an aggregation of validators does not account for. This is a hint at the value of collecting judgments directly from the event experiencers, as a more appropriate source for the systems to learn first-hand evaluations—past NLP research did that through the readers' reconstructions alone. Therefore, from Experiment 1, we conclude that the task of inferring the 21 appraisal dimensions from a text that describes an event is viable: The systems can model both emotional and non-emotional states using fine-grained, dimensional information rather than emotion classes. Their classification performance also improves upon past work based on a

smaller set of appraisal variables (i.e., Hofmann et al. [2020] obtained  $F_1 = .70$  on a different data set, labeled only by readers).

*6.2.2 Experiment 2: Reconstruction of Emotions from Appraisals.* Using the systems above, which go from text to appraisals, allows us to characterize emotional contents without predefining their possible discrete values (*anger, disgust, etc.*). With the second experiment, we move our attention to such values, which are the phenomena of interest *par excellence* for emotion analysis. Our goal is to investigate the link between the 21 cognitive dimensions and the recognition of emotions only from a computational perspective, thus verifying if the appraisal-to-emotion mapping is feasible: We analyze models that take appraisals as inputs and produce a discrete emotion label as an output. Specifically, we represent events either with the self-reported appraisals (for  $A^{\text{Gold}} \rightarrow E_{\text{model}}$ ) or with the appraisals predicted by  $T \rightarrow A_{\text{model}}$  (for  $A^{\text{Pred}} \rightarrow E_{\text{model}}$ ) from Experiment 1. In both cases, the emotion classifiers do not have (direct) access to the text.

Results are in Table 9, separated between the setting where appraisals are Booleans, and one where they are treated as continuous values (scaled within the interval [0:1]). Surprisingly, the gold appraisals do not systematically yield better performance than the predicted dimensions. In fact, by looking at the Discretized framework, we find that each type of input enhances the detection of different emotions. For instance, *guilt, anger, shame, and trust* are better identified when the gold appraisal ratings are available to the model, while the recognition of *boredom* is facilitated by predicted appraisal values. Still, on a macro-level numbers indicate no discrepancy between the access to the

**Table 9**

Models' performance (Precision, Recall,  $F_1$ ) on recognizing emotions, having access only to the annotated ( $A^{\text{Gold}} \rightarrow E_{\text{model}}$ ) or predicted appraisal dimensions ( $A^{\text{Pred}} \rightarrow E_{\text{model}}$ ). Standard deviations are reported in Table 18 in the Appendix. Discretized/Scaled: input appraisals are represented as Boolean values/as values in the [0:1] interval.  $\Delta$ :  $F_1$  difference between the models leveraging appraisal predictions and gold ratings.

| Emotion    | Discretized                                    |     |       |  |     |       |              | Scaled   |     |       |  |     |       |              |
|------------|--|-----|-------|--|-----|-------|--------------|--|-----|-------|--|-----|-------|--------------|
|            | $A^{\text{Gold}}_{\text{model}} \rightarrow E$ |     |       | $A^{\text{Pred}}_{\text{model}} \rightarrow E$ |     |       | $\Delta F_1$ | $A^{\text{Gold}}_{\text{model}} \rightarrow E$ |     |       | $A^{\text{Pred}}_{\text{model}} \rightarrow E$ |     |       | $\Delta F_1$ |
|            | P  | R   | $F_1$ | P  | R   | $F_1$ |              | P  | R   | $F_1$ | P  | R   | $F_1$ |              |
| Anger      | .35  | .46 | .40   | .35  | .33 | .34   | -.06         | .35  | .46 | .40   | .28  | .57 | .37   | -.03         |
| Boredom    | .44  | .47 | .46   | .54  | .69 | .60   | +.14         | .47  | .62 | .54   | .46  | .60 | .52   | -.02         |
| Disgust    | .36  | .32 | .34   | .42  | .33 | .37   | +.03         | .49  | .44 | .46   | .58  | .20 | .29   | -.17         |
| Fear       | .22  | .33 | .26   | .25  | .47 | .32   | +.06         | .27  | .34 | .30   | .26  | .46 | .33   | +.03         |
| Guilt      | .30  | .23 | .26   | .25  | .08 | .12   | -.14         | .32  | .26 | .28   | .29  | .15 | .19   | -.09         |
| Joy        | .28  | .30 | .28   | .31  | .31 | .30   | +.02         | .29  | .30 | .29   | .31  | .24 | .25   | -.04         |
| No emo.    | .46  | .46 | .46   | .46  | .29 | .35   | -.11         | .50  | .46 | .47   | .53  | .23 | .31   | -.16         |
| Pride      | .33  | .39 | .35   | .27  | .48 | .34   | -.01         | .35  | .38 | .35   | .29  | .33 | .29   | -.06         |
| Relief     | .28  | .13 | .18   | .33  | .13 | .19   | +.01         | .32  | .18 | .23   | .36  | .21 | .26   | +.03         |
| Sadness    | .31  | .29 | .30   | .30  | .39 | .34   | +.04         | .37  | .35 | .36   | .36  | .24 | .28   | -.08         |
| Shame      | .26  | .22 | .24   | .25  | .19 | .21   | -.03         | .27  | .24 | .25   | .29  | .37 | .33   | +.08         |
| Surprise   | .44  | .44 | .43   | .46  | .44 | .44   | +.01         | .46  | .43 | .44   | .63  | .22 | .31   | -.13         |
| Trust      | .21  | .14 | .17   | .29  | .10 | .15   | -.02         | .30  | .23 | .26   | .23  | .35 | .27   | +.01         |
| Macro avg. | .33  | .32 | .32   | .34  | .32 | .32   | +.00         | .37  | .36 | .35   | .38  | .32 | .31   | -.05         |

gold annotations and to the output produced by  $T \rightarrow A_{\text{model}}$ . The two models perform on par ( $\Delta F_1 = 0$ ), with an average macro- $F_1$  of .32. This finding is per se promising, as it sets the ground for appraisal-based emotion classifiers that operate independently of the help of gold information, without producing worse-quality output. Differences between the gold and predicted inputs are more marked in the Scaled set-up. The gold variants lead to a better performance than the predicted appraisal scores (macro- $F_1 = .35$  vs. macro- $F_1 = .31$ ), with *disgust*, *surprise*, and *pride* benefitting the most from such information. Compared with the Discretized results, the  $A^{\text{Pred}} \rightarrow E_{\text{model}}$  here reaches a 1pp-lower  $F_1$ .<sup>19</sup>

Focusing on the emotion differences within  $A^{\text{Pred}} \rightarrow E_{\text{model}}$ , we see a remarkable gap of 48pp between the lowest and highest  $F_1$  (33pp in the Scaled scenario): The information learned by the model is substantially more useful for a subset of emotions, which suggests that appraisals might not come equally handy in classifying all events. At the same time, we acknowledge that all obtained  $F_1$  scores seem tepid, irrespective of the input representation and the input type. Our results should be interpreted by taking into account that a random decision in the scaled setting leads to .08  $F_1$ , and that similar performances can be found in psychological studies that predict emotion from appraisals (with the difference that they report accuracy instead of  $F_1$ ). Smith and Ellsworth (1985) achieve an accuracy of 42% for the task of classifying 15 emotions based on 6 appraisal variables. Frijda, Kuipers, and Ter Schure (1989) have an accuracy of 32% in recognizing 32 emotions using 19 appraisals, Scherer and Wallbott (1997) report a score of 39% in discriminating between 7 emotions using 8 input dimensions, and Israel and Schönbrodt (2019) obtain an overall accuracy of 27% when recognizing 13 emotions with 25 appraisals. Thus, the data-derived mapping from appraisals to emotions aligns with past research. This is an important indicator for the quality of our data: The ratings in crowd-enVENT are comparable to those collected in the past by experts who did not conduct their studies via crowdsourcing. In practice, this means that our models can exploit the link between appraisal variables and emotions similarly well as found in psychology.

To understand if the performance of the emotion prediction based on appraisals is promising for joint models that also consider text, we now compare the predictive power of  $A^{\text{Gold}} \rightarrow E_{\text{model}}$  and  $A^{\text{Pred}} \rightarrow E_{\text{model}}$  against those based on text and text only. Such a comparison provides a partial answer to RQ4, because it shows if the appraisal-based systems capture information that the text-based models (typically used in emotion analysis) cannot, and vice versa. Table 10 shows the results. It summarizes how humans reconstruct the prompting emotion labels ( $T \rightarrow E_{\text{human}}$ ), and how automatic systems carry out the same task ( $T \rightarrow E_{\text{model}}$ ). Among the positive emotions, *joy* seems the most difficult to recognize for the system (.45 $F_1$ ), which achieves .63 and .74 $F_1$  on *relief* and *trust*, respectively. The lowest automatic performance on negative emotions regards those with fewer annotated samples, namely, *shame* (.51 $F_1$ ) and *guilt* (.48 $F_1$ ). Classes that are predicted better by the computational model than by human validators are *boredom*, *disgust*, *shame*, *surprise*, and *trust*, as well as *no emotion*. It should be noted here that correctly recognizing *no emotion* is challenging, as many participants reported events in which they remained apathetic but that are typically emotional (e.g., the loss of a dear person).

19 We experimented with the appraisal representation in [1:5] instead of scaling them to [0:1], and we obtained an overall macro- $F_1 = .31$  for  $A^{\text{Gold}} \rightarrow E_{\text{model}}$  and a macro- $F_1 = .22$  for  $A^{\text{Pred}} \rightarrow E_{\text{model}}$ , thus  $\Delta = .09$ .

**Table 10**

Emotion recognition performance (Precision, Recall,  $F_1$ ) of the models based only on text ( $T \rightarrow E$ ) or both text and appraisals ( $TA \rightarrow E$ ). Standard deviations are reported in Table 19 in the Appendix. Delta values show the differences between the Macro- $F_1$  scores of the indexed models.

| Emotion    | (a)<br>T→E<br>human |     |       | (b)<br>T→E<br>model |     |       | $\Delta_{(a)}^{(b)}$ | (c)<br>TA <sup>Gold</sup> →E<br>model |     |       | $\Delta_{(b)}^{(c)}$ | (d)<br>TA <sup>Pred</sup> →E<br>model |     |       | $\Delta_{(c)}^{(d)}$ | $\Delta_{(b)}^{(d)}$ |
|------------|---------------------|-----|-------|---------------------|-----|-------|----------------------|---------------------------------------|-----|-------|----------------------|---------------------------------------|-----|-------|----------------------|----------------------|
|            | P                   | R   | $F_1$ | P                   | R   | $F_1$ |                      | P                                     | R   | $F_1$ |                      | P                                     | R   | $F_1$ |                      |                      |
| Anger      | .50                 | .66 | .57   | .57                 | .52 | .53   | -.04                 | .56                                   | .58 | .57   | +.04                 | .56                                   | .58 | .57   | .00                  | +.04                 |
| Boredom    | .78                 | .69 | .73   | .81                 | .87 | .84   | +.11                 | .83                                   | .84 | .83   | -.01                 | .83                                   | .83 | .83   | .00                  | -.01                 |
| Disgust    | .85                 | .53 | .65   | .74                 | .59 | .66   | +.01                 | .70                                   | .63 | .66   | .00                  | .70                                   | .63 | .66   | .00                  | .00                  |
| Fear       | .66                 | .83 | .73   | .65                 | .66 | .65   | -.08                 | .69                                   | .66 | .67   | +.02                 | .69                                   | .66 | .67   | .00                  | +.02                 |
| Guilt      | .48                 | .58 | .53   | .63                 | .39 | .48   | -.05                 | .64                                   | .54 | .58   | +.10                 | .63                                   | .52 | .56   | -.02                 | +.08                 |
| Joy        | .41                 | .62 | .49   | .53                 | .40 | .45   | -.04                 | .49                                   | .48 | .48   | +.03                 | .49                                   | .46 | .47   | -.01                 | +.02                 |
| No emo.    | .72                 | .21 | .33   | .66                 | .50 | .55   | +.22                 | .61                                   | .54 | .56   | +.01                 | .62                                   | .53 | .56   | .00                  | +.01                 |
| Pride      | .52                 | .69 | .59   | .48                 | .64 | .54   | -.05                 | .51                                   | .61 | .55   | +.01                 | .50                                   | .62 | .55   | .00                  | +.01                 |
| Relief     | .56                 | .74 | .64   | .65                 | .63 | .63   | -.01                 | .58                                   | .67 | .62   | -.01                 | .58                                   | .68 | .62   | .00                  | -.01                 |
| Sadness    | .54                 | .76 | .63   | .52                 | .68 | .59   | -.04                 | .61                                   | .69 | .65   | +.06                 | .59                                   | .69 | .63   | -.02                 | +.04                 |
| Shame      | .48                 | .48 | .48   | .53                 | .50 | .51   | +.03                 | .55                                   | .47 | .50   | -.01                 | .55                                   | .45 | .49   | -.01                 | -.02                 |
| Surprise   | .57                 | .33 | .42   | .53                 | .54 | .53   | +.11                 | .58                                   | .44 | .49   | -.04                 | .58                                   | .44 | .50   | +.01                 | -.03                 |
| Trust      | .95                 | .36 | .52   | .73                 | .75 | .74   | +.22                 | .76                                   | .71 | .73   | -.01                 | .76                                   | .70 | .72   | -.01                 | -.02                 |
| Macro avg. | .62                 | .58 | .56   | .62                 | .59 | .59   | +.03                 | .62                                   | .60 | .61   | +.02                 | .62                                   | .60 | .60   | -.01                 | +.01                 |

The relative improvement of the systems over the validators is less pronounced than in Experiment 1 but is still present: The system surpasses humans by 3pp (Macro- $F_1 = .56$  for the human validators vs.  $.59F_1$  for  $T \rightarrow E_{\text{model}}$ ). We take it as evidence of the success of the automatic models, but also of the subjective nature of the emotion recognition task: Even when aggregated into the most representative judgment of the crowd, the readers' annotation does not necessarily correspond to the original emotion experience (as spelled out in Section 5.4, some of their misclassifications happen between similar emotion classes).

Importantly, the results of  $T \rightarrow E_{\text{model}}$  are substantially higher than what we achieved with the appraisal-informed classification of  $A^{\text{Pred}} \rightarrow E_{\text{model}}$  and  $A^{\text{Gold}} \rightarrow E_{\text{model}}$ . Some  $F_1$  scores of the predicted appraisal-based model are on par with the textual classification, either with  $T \rightarrow E_{\text{model}}$  (e.g., *boredom*, *surprise*) or  $T \rightarrow E_{\text{human}}$  (e.g., *no-emotion*, *surprise*). However, overall numbers clearly point to the conclusion that appraisals alone do not bear an advantage over the textual representations of events. This is unsurprising, because appraisals are grounded in (and in fact stem from) a salient experience, while the two models under consideration are aware of *how* a circumstance is evaluated but not *what* circumstance is evaluated, that is, the opposite of  $T \rightarrow E_{\text{model}}$ . Therefore, as we move on to the next experiment, we contextualize appraisals with textual information, to understand if they can complement each other.

**6.2.3 Experiment 3: Reconstruction of Emotions Via Text and Appraisals.** We gauge understanding of the extent to which appraisals contribute to emotion classification by comparing models that have access to both the text and the (predicted or original) appraisals with the automatic emotion predictor based solely on the text.

Columns (c) and (d) in Table 10 show the results of the pipelines  $TA^{\text{Gold}} \rightarrow E_{\text{model}}$  and  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ . Column  $\Delta_{(b)}^{(c)}$  shows the improvement of the pipeline that integrates text and appraisal information. The current experiment returns a different picture than Experiment 2. Here we see that appraisals *enhance* emotion classification to various degrees for the different emotions. Overall, they allow the model to gain 2pp  $F_1$ . While this might seem a minor improvement, for some classes the increase is more substantial, namely, for *guilt*, *sadness*, *anger*, and *joy* (+10pp, +6pp, +4pp, and +3pp, respectively). This amelioration mostly stems from an increased recall, that is, finding emotions with the help of appraisals seems easier. Only for some emotions there is a drop in  $F_1$ , particularly for *surprise* (−4pp).

The fact that this model relies on gold appraisal information represents a principled issue, because gold appraisals are typically not available in classification scenarios. Therefore, as a last analysis, we examine  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ , which replaces the writers' ratings with predicted values. We use the  $T \rightarrow A_{\text{model}}$  regressor trained in Experiment 1 and remap the continuous values that they produce in the [0:1] interval back to the 5-point scale used by the human annotators.<sup>20</sup> We observe that the performance remains consistent with the gold-aware systems (Macro- $F_1$  is only 1pp lower), in line with our previous finding that leveraging appraisal predictions as inputs is not detrimental for the overall emotion recognition task, and that the benefit is more substantial for some emotions than others.

Additionally, the result that these cognitively motivated features do not improve the reconstruction of some emotion categories (e.g., *disgust*, *relief*) is coherent with a finding that emerged earlier (Experiment 2): Appraisals might not be equally handy to classify all events. This suggests that, at times, a text might contain sufficient signals to support an appropriate classification decision. After all, we have observed that appraisals themselves are fairly “contained” in text, as they can be predicted. Thus, one could argue that text alone is informative enough, but the help of appraisals becomes evident with other emotion categories (*guilt*, *sadness*, *anger*, and *joy*). Hence, there are cases in which exploiting them as input features (standing as explicit background knowledge involved in the text interpretation) pushes the classifiers toward the correct inference. Briefly, to answer RQ4, we find that the integration of appraisals into an emotion classifier can have a (partial but) beneficial impact on its observed performance.

The role of appraisal dimensions can be better appreciated by discussing difficult-to-judge event descriptions. In the analysis of tables 6 and 7 (Section 5.4), we conjectured that texts where validators misunderstood the experience of the writers are more likely to be correctly classified (emotion-wise) by a model that has access to the (correct) appraisal information. To test our hypothesis, we extract 400 instances from the validation set that have the highest G–V appraisal agreement value, and 400 instances with the lowest agreement. We evaluate classification with and without appraisals ( $TA^{\text{Gold}} \rightarrow E_{\text{model}}$  and  $T \rightarrow E_{\text{model}}$ ) on these two sets of instances.

$F_1$  scores averaged over five runs of the models are shown in Table 11. The classification performance is lower for the 400 datapoints on which annotators disagreed the most (column Low), regardless of the input. In both agreement groups, the predictions informed by appraisals lead to superior  $F_1$ : There is an improvement of 2pp for instances

<sup>20</sup> We remap to discrete values both for a direct comparison to the original appraisals and because Experiment 2 showed that such framework works better than the scaled alternative, although to a minimal extent.

**Table 11**

Appraisal contribution to the emotion classification of texts with high/low appr. IAA. Scores are  $F_1$ .

|       |      | Agreement |     |
|-------|------|-----------|-----|
|       |      | High      | Low |
| Appr. | w/o. | .60       | .54 |
|       | w.   | .62       | .57 |

with high appraisal agreement, and a higher improvement for those with low appraisal agreement (+3pp), as expected.

### 6.3 Error Analysis

While we provided evidence that appraisal predictions help emotion recognition in some cases, it remains unclear how they help—that is, whether there are cases in which they systematically improve the prediction that would be taken without any access to appraisals, and what types of mistakes they prevent. To understand when the input appraisals' access is convenient, we conduct quantitative and qualitative analyses.

**6.3.1 Quantitative Analysis.** The two confusion matrices in Figure 11 are a break-down of the performance reported in Table 10 for  $T \rightarrow E_{\text{model}}$  and  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ . They contain the counts of text labeled correctly (on the diagonal, representing true positives – TP) and incorrectly (off-diagonal), averaged across five runs of the models. Note that the values for the emotions of *guilt* and *shame* are multiplied by two to simplify the comparison with the other emotions. These numbers show what emotion pairs are better disambiguated through the knowledge of the 21 cognitive variables, and what pairs, on the contrary, suffer from it. We summarize the difference between them in Figure 12.

We have already seen that predictions of *anger*, *fear*, *guilt*, *joy*, and *sadness* benefit particularly from appraisal features (Table 10). The comparison of the diagonals in the two heatmaps mirrors the improvements across such labels:  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$  predicts on average 6.8 *guilt* TP (13.6/2) more than  $T \rightarrow E_{\text{model}}$ ; the count of TP of *anger* increases by 3.4; for *joy* there are 1.2 more TP, while for *fear* 0.4. For *sadness*, the improvement in  $F_1$  cannot be found in the number of TP instances, which in fact decreases by 2.4. It rather stems from a reduction in false positives (off-diagonal sum in the *sadness* columns: 63.6 for  $T \rightarrow E_{\text{model}}$  and 46 for  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ , which is mostly due to a better disambiguation of *sadness* from *anger*). We also notice that the correct and incorrect predictions of the two models are distributed unevenly across the 13 emotions. Emotion pairs that are most often confused by  $T \rightarrow E_{\text{model}}$  are (gold/predicted) *disgust/anger* (16.8 FP), *no emotion/boredom* (10.4), *pride/joy* (15.4), *guilt/shame* (12.2 = 24.4/2 in the matrix), *relief/pride* (11.6), and *joy/relief* (11.2). Appraisal information in fact slightly adds confusion to these particularly challenging classes (*disgust/anger*: 1, *no emotion/boredom*: 3.2, *pride/joy*: 0.4, *relief/pride*: 0.8, *joy/relief*: 1), except for *guilt/shame*, where confusion declines by 4.6 (9.2/2) FP.

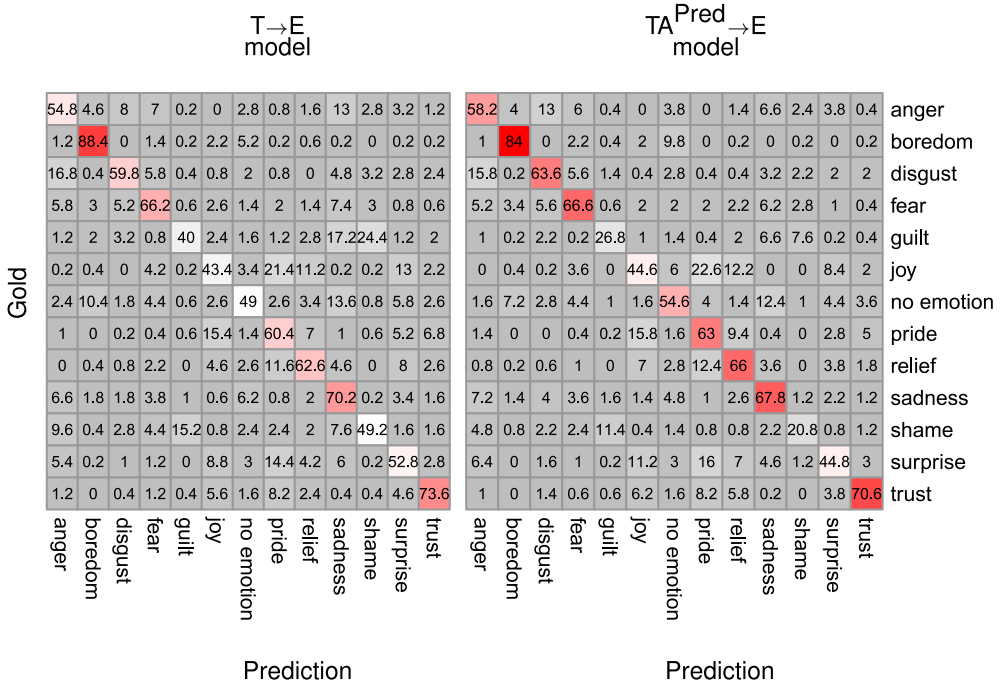


Figure 11

Confusion matrices to compare  $T \rightarrow E_{\text{model}}$  and  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ . The numbers represent counts of correct predictions (on diagonal) and mistakes (off-diagonal) averaged across 5 runs. Numbers in the guilt and shame rows are multiplied by 2 such that they are comparable to the other emotions; therefore, the values can also be interpreted as percentages, because the number of instances per emotion in the test set is 100. Higher values on the diagonal mean better performance; vice versa for the off-diagonal cells.

6.3.2 Qualitative Analysis. As a last analysis, we manually inspect the interaction between appraisals and emotion predictions. We show here 20 examples of texts whose classification is modified for the better by specific appraisal information (Table 12), selected based on the agreement reached by the annotators.

The appraisal-aware model rectifies the example corresponding to Id 64 (“I ate some food from the fridge which belonged to my flatmate without her permission”) from *sadness* to *guilt*. The dimensions relevant for disentangling these two emotions are *pleasantness*, *unpleasantness*, and *situational control* (Smith and Ellsworth 1985). The classification improvement here correlates precisely with a low *situational control* (1) and moderate *pleasantness* (3)—a common appraisal association of an event annotated for *sadness* has low values. Also *own responsibility* (5) and moderate *own control* (3) might have played a role. We see a similar pattern for example 69, initially associated with *shame* but corrected to *guilt* with the dimensions related to the perception of one’s agency.

Example 61 (“my mother made me feel like a child”) shows how *anger* is disambiguated from *shame*. There, a score of 4 is predicted for *other responsibility*, then used as input. This makes intuitive sense: The dimension is typical of events in which the experiencer undergoes what someone else has caused (“my mother”), and in fact, it differentiates *anger* from other negative emotions such as *shame* and *guilt* (where the

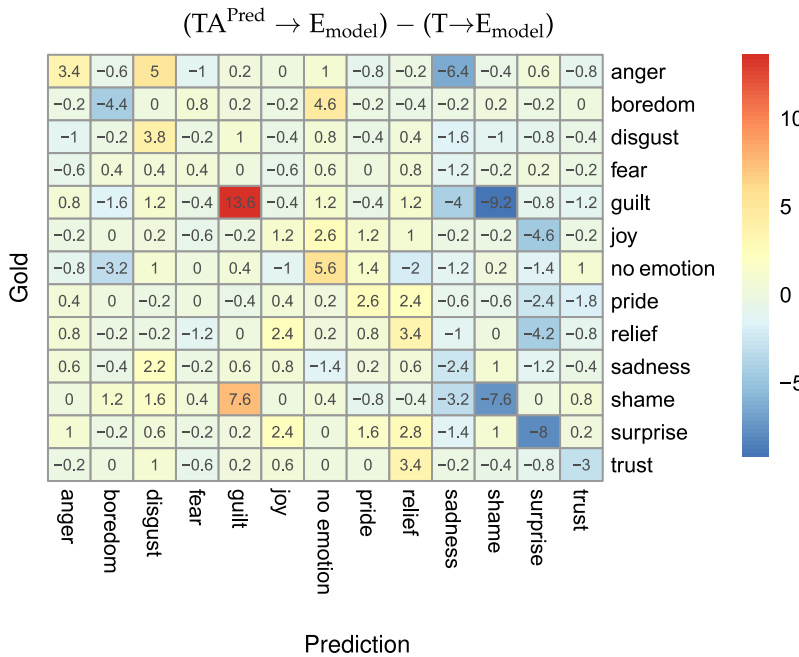


Figure 12

Cell-by-cell difference between  $TA^{Pred} \rightarrow E_{model}$  and  $T \rightarrow E_{model}$  in Figure 11. Numbers represent the comparison between the count of texts that both of them correctly predicted (on diagonal) and those that they both misclassified (off-diagonal), averaged across 5 runs of the models. Red cells are those where  $TA^{Pred} \rightarrow E_{model}$  performs better than  $T \rightarrow E_{model}$ ; blue cells show the opposite case. Color intensity corresponds to the absolute value of the numbers.

responsibility falls on the self) (Smith and Ellsworth 1985). Anger is further characterized by patterns in *own control* and *others' control*, with the former being lower than the latter (Smith and Ellsworth 1985; Scherer and Wallbott 1997). Example 60 (“someone moved my personal belongings”) further highlights their importance (*own control*: 2, *others' control*: 5).

The emotion of *disgust* is confused by  $T \rightarrow E_{model}$  with *surprise* and *pride* in examples 4 and 71, respectively. Once more, these events are about something caused or belonging to *others* (accordingly, *other responsibility* and *others' control* are rated both as 5, and *own responsibility* as 1). The prediction of *not consider* in the lower end of the rating scale might have been taken as a further indicator of the negative connotation of the text by  $TA^{Pred} \rightarrow E_{model}$ . *Suddenness*, *urgency*, and *goal relevance*, which the theories correlate to *fear* (Scherer, Schorr, and Johnstone 2001b), stand out in “When I found out my mum had cancer” (where they are all rated as 5). Further, the correct prediction for example 7 (“I bought my car recently”) and example 2 (“ I got my degree”) is accompanied by strong degrees of appraisals that are typical of *pride – own control* (4 and 2), *own responsibility* (5 and 5), *goal relevance* (5 and 5), and *goal support* (5 and 5).

In general, for positive emotions such as *relief*, *trust*, *surprise*, and *pride*, it is more difficult to identify patterns of appraisals that differentiate them, and even annotators disagree more. This could be due to our set of 21 variables, which does not include some

**Table 12**

Examples in which the  $T \rightarrow E_{\text{model}}$  is corrected by the  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ . The top (bottom) part of the table shows the examples where the G-V agreement is high (low) on appraisal evaluations (RMSE).

| Id | Gold    | $T \rightarrow E_{\text{model}}$ | $TA^{\text{Pred}} \rightarrow E_{\text{model}}$ | RMSE | Text   |
|----|---------|----------------------------------|---|------|--|
| 1  | fear    | sadness                          | fear  | 1.02 | <i>When I found out my mum had cancer</i>  |
| 2  | pride   | surprise                         | pride   | 1.04 | <i>I got my degree</i>   |
| 3  | relief  | trust                            | relief  | 1.04 | <i>When my child settled well into school</i>  |
| 4  | disgust | surprise                         | disgust   | 1.08 | <i>someone dropped meat on the floor at work and used it.</i>  |
| 5  | no emo. | boredom                          | no emo.   | 1.15 | <i>travelling to Cooktown Queensland</i>   |
| 6  | anger   | anger                            | disgust   | 1.15 | <i>I felt ... when my partner waited to tell me 3 months later that he had texted his ex-partners.</i> |
| 7  | pride   | joy                              | pride   | 1.26 | <i>I bought my car recently</i>  |
| 8  | shame   | guilt                            | shame   | 1.27 | <i>broke an expensive item in a shop accidentally</i>  |
| 9  | relief  | surprise                         | relief  | 1.28 | <i>I'm supposed to speak publicly but the event gets cancelled.</i>                                    |
| 10 | sadness | surprise                         | sadness   | 1.29 | <i>I found out that my ex-wife was divorcing me.</i>   |
| 60 | anger   | trust                            | anger   | 1.36 | <i>someone moved my personal belongings</i>  |
| 61 | anger   | shame                            | anger   | 1.40 | <i>my mother made me feel like a child</i>   |
| 62 | anger   | sadness                          | anger   | 1.41 | <i>I was lied to about money</i>   |
| 63 | anger   | sadness                          | anger   | 1.47 | <i>when youths dont respect their elders</i>   |
| 64 | guilt   | sadness                          | guilt   | 1.53 | <i>I ate some food from the fridge which belonged to my flatmate without her permission</i>            |
| 65 | relief  | pride                            | relief  | 1.54 | <i>I passed my Irish language test</i>   |
| 66 | no emo. | relief                           | no emo.   | 1.52 | <i>when getting my roof inspected for storm or wind damage.</i>  |
| 67 | relief  | joy                              | relief  | 1.67 | <i>When I found my dog</i>   |
| 68 | no emo. | boredom                          | no emo.   | 1.67 | <i>Completing my degree. Should have felt pride, didn't feel ... but a headache.</i>                   |
| 69 | guilt   | shame                            | guilt   | 1.70 | <i>I took the last shirt in the right size when my friend wanted it too.</i>                           |
| 70 | joy     | surprise                         | joy   | 1.73 | <i>When I received a invite to a wedding</i>   |
| 71 | disgust | pride                            | disgust   | 2.02 | <i>His toenails were massive</i>   |

dimensions recently proposed to tackle positive emotions specifically (Yih, Kirby, and Smith 2020).

Another class for which  $TA^{\text{Pred}} \rightarrow E_{\text{model}}$  tends to recover the correct label is *no emotion*, that  $T \rightarrow E_{\text{model}}$  mistakes for *boredom* (examples 5 and 68) and *relief* (example 66). All of them can be thought of as non-activating states, but the confusion with *boredom* is especially foreseeable, in that its low motivational relevance (i.e., *goal relevance*), *pleasantness* and *unpleasantness* (Smith and Ellsworth 1985; Yih et al. 2020), is shared by the neutral state of *no emotion*. Example 5 (“travelling to Cooktown Queensland”) partially confirms this pattern, as *goal relevance* and *unpleasantness* are rated by the model as 1 (but *pleasantness* as 4).

## 7. Discussion and Conclusion

*Contributions and Summary.* This article is concerned with appraisal theories, and investigates the representation of appraisal variables as a useful tool for NLP-based emotion analysis: Starting from the collection of thousands of event descriptions in English, it conducts a detailed analysis of the data, it discusses its annotations from the writers’

and readers' perspectives, and, lastly, it describes experiments to predict emotions and appraisals, separately and jointly.

We propose the use of 21 appraisal dimensions based on an extensive discussion of theories from psychology. Appraisals formalize criteria with which humans evaluate events. As such, they are cognitive dimensions that underly emotion episodes in real life—a type of information that can facilitate systems in interpreting implicit expressions of emotional content. They also allow representing the structured differences among the phenomena in question. Nevertheless, they are mostly dismissed in the literature of affective computing in text. We provide evidence that their patterns can be leveraged to represent emotions and are beneficial for the modeling of specific classes. In fact, under the assumption that appraisals *are* emotions, modeling can take place without the need to decide on a set of emotion labels in advance. A process of this type is similar to the use of valence and arousal among studies in the field based on dimensional models from psychology. At the same time, appraisals are a formalism with a stronger expressive power, as they can differentiate emotion categories via more fine-grained underlying mechanisms (Smith and Ellsworth 1985), have a theoretically motivated mapping to emotions, and fit the analysis of events from the perspective of the people who lived through them. In contrast, valence and arousal models focus on affect, which is more related to a subjective feeling than a cognitive processing module.

Our appraisal labels are the result of a crowdsourcing study. Participants were tasked to describe events that provoked a specific emotion in them; further, they qualified their experience along the 21 appraisals. This gold standard data served as a basis for an evaluation of other human annotators: being presented with (a subset of) the event descriptions, readers had to recover both the original emotion and the original appraisals. In turn, their judgment served for comparison with multiple models, aimed at determining if the task of appraisal prediction is feasible, and how such predictions can be exploited for the automatic detection of emotion from text. Validators and systems turned out to perform similarly on the task of emotion and appraisal prediction. Therefore, we conclude that text provides information for humans and classifiers to recover appraisals (RQ1).

It is noteworthy that the readers agree to a higher extent with other readers on the appraisal assignment than with the texts' authors. Based on qualitative analyses, we exemplified the correspondence between textual realizations and appraisal ratings (RQ2) rated by both systems and humans, highlighting how certain texts have a more typical emotion connotation, while others require more elaborate interpretation (e.g., by focusing on different parts of the texts, different appraisals might fit a description). In most cases, the descriptions we collected allow for an event assessment that is faithful to the original one. From a quantitative angle, we found a significant relation between validators' traits and their reliability. Differences between the annotation conducted by readers with dissimilar traits are, however, small (RQ3). We thus deduce that appraisals can be annotated in traditional annotation set-ups, just like emotions. Finally, we saw that appraisals help to predict certain emotion categories, as they correct mistakes of a system relying on text alone (RQ4). Overall, appraisal theories proved to be a valid framework for further research into the modeling of emotions in text.

We make crowd-enVENT publicly available. Of the 6,600 descriptions, 1,200 instances are also labeled from the readers' perspective. Further, we prepare our implementation for future use and will make it available as easy-to-use pretrained models, to facilitate upcoming research on the generalizability of appraisals in other textual domains. crowd-enVENT includes variables that have not all been fully analyzed in this article. This brings us to future work.

*Future Work.* Our analyses of the data, inter-annotator agreement, and models raise a set of important future work items. First, we tackled the impact of appraisals on the resolution of misclassification. With a manual analysis, we interpreted the differences between the models' behaviors by attempting to match the predicted appraisal patterns to the patterns documented by the theories. Their correspondence indicates that appraisals lend themselves well as a tool to introspect and explain machine learning models, but without a robust, quantitative approach to the problem, which goes beyond the scope of this article, our investigation has only scratched the surface of their potential to explain emotion decisions.

The patterns identified in the qualitative discussion support the idea that specific dimensions disambiguate emotions in different cases, depending on the topic/event in question. This puts forward another promising research direction, namely, emotion prediction conditioned on particular interpretations of events. Understanding if and when some appraisals have a systematic effect on a classifier's predictions would have a valuable application: Empathetic dialogue agents could grasp internal states better by asking users to clarify the relevant evaluation dimensions (e.g., "did you feel responsible for the fact?", "could you foresee its consequences?"). In addition, we only made use of one appraisal vector for modeling (i.e., that representing or being predicted by the perspective of writers). Can we build person-specific emotion and appraisal predictors guided by demographic properties, personality traits, or current emotion state? Although we did not find any evidence that personal attributes influence inter-annotator agreement, it is possible that incorporating this information in models might make their inferences more fitting to the expectations of users.

We highlighted the slight but consistent mismatch between humans and machine learning models. The latter perform better, but strictly speaking, the two did not undertake the same task: The models were trained on the writers' perspective, while the readers attempted to minimize the distance between their own point of view (based on prior emotion experiences and subjective interpretations) and that of some unknown text author. A fairer comparison would adopt zero-shot learning, for instance with natural language inference models or transformers trained for text generation.

The corpus we collected gives the opportunity to analyze what lies behind a particular emotion choice. Can we predict/explain the variations of emotion assignments from validators with the help of their appraisals? We found that even when they do not recover the gold emotion label, they can still be correct about appraisals. This motivates an adaption of the used measures of inter-annotator agreement toward an account of the fundamentally similar understanding of texts: Emotion disagreements that come hand in hand with high appraisal agreement could be weighted as less relevant. As an alternative, future work could study if wrong emotion judgments are considered valid by the writers themselves, by extending the corpus construction task to a multi-label scenario, where the writers indicate secondary emotions that are acceptable interpretations of their experiences.

While we focused on English, our corpus construction procedure can easily be transferred to other languages and scaled to larger amounts of texts. Given the finding that the readers' annotation is reliable, similar data can be collected for other languages, for specific domains, and going beyond event descriptions induced experimentally—an endeavor that has recently taken its first steps toward verbal productions extracted from social media (Stranisci et al. 2022). Our expectation is that the full value of appraisal information in emotion-laden data will flourish with more spontaneously produced and (ideally) longer pieces of texts, which can give both human annotators and classifiers more context to picture the evaluation stage of an affective

episode. Moving to different domains would also be important to verify if appraisals promote the recognition of a handful of emotion classes as in our work, or if our results are an effect of the events described by the writers, and actually, in other texts many more emotion classes can be better differentiated through explicit appraisal criteria.

Lastly, appraisals encompass a range of experiences, which they can account for from various perspectives, including those of the entities mentioned in text (Troiano et al. 2022). This makes them advantageous for studies other than emotion modeling, interested in understanding human judgments more broadly, like argumentative persuasion, analyses of evaluations from text, and streams of research aimed at explaining their models in a cognitively motivated manner.

*Ethical Considerations.* The task of recognizing appraisals (and emotion categories) is and will be imperfect. As Mohammad (2022) puts it: “it is impossible to capture the full emotional experience of a person [...]. A less ambitious goal is to infer some aspects of one’s emotional state”. This applies to our work as well. The taxonomy of 21 appraisal criteria contains a structured and useful guideline to investigate certain evaluations involved in humans’ affective reactions. We praised their expressive advantage over the feeling and motivational traditions. Still, they are not sheltered from criticism (Roseman and Smith 2001). For instance, event evaluations are in principle countless; it might also be doubted that an appraisal, or the group of appraisal variables as a whole, is always sufficient and/or necessary for an emotion to happen, and consequently, that is always an appropriate approach for computational analyses.

We publish the raw, unaggregated judgments to account for the naturally diverse emotion recognition sensibilities of our validators, who ended up producing many interpretations for the same texts (with the extreme case of the descriptions produced for *E = no emotion*, in which the validators could read an emotional reaction). Allowing readers to participate only once was our strategy to collect divergent voices, precisely. For a similar reason, we encouraged variety among the descriptions of events in the generation phase of crowd-enVENT.

Other than linguistic diversity and disagreeing annotations, crowd-enVENT displays a rich range of demographics made publicly available. Nevertheless, we do not see any particular risk regarding the profiling of our participants. First, we pseudonymize their IDs with respect to their privacy. Second, for machine learning systems to learn personal expressive patterns, private affective behaviors, or personal preferences, a considerable amount of data from the same person would be needed. Instead, crowd-enVENT has an inconsistent number of texts coming from different writers, and many of them produced only one description. Third, we worked with experimental texts: Although it is reasonable to assume that they represent the participants’ language use, in a more spontaneous occasion people might have written about other aspects of their life, and might not necessarily have expressed emotion content by focusing on events. Fourth, such texts are taken in isolation: Within larger textual contexts, they could be associated with different emotions.

Like other studies in computational emotion analysis, ours endorses the assumption that language is a window into people’s mental lives. As such, it favors human-assisting applications (e.g., for chatbots in the healthcare domain) but is also prone to misuse (e.g., to profile people’s mental well-being and preferences, to decide on their everyday lives’ opportunities). We condemn all future applications of the outcome of our work breaching people’s privacy or testing their emotional states and appraisals without consent.

## A. Appendix

### A1. Comparison of Appraisal Dimensions Formulations to the Literature

Table 13 reports a comparison of the appraisal statements that we used in the generation phase of crowd-enVENT with the original formulations in Scherer and Wallbott (1997) and Smith and Ellsworth (1985). Our statements were rated from 1 to 5 (with 1 being “not at all” and 5 “extremely”). Similarly, answers for Scherer and Wallbott (1997) were picked on a 5-point Likert scale between “not at all” to “moderately” to “extremely,” with an addition option “N/A.” Smith and Ellsworth (1985) chose a 11-point scale.

**Table 13**

Comparison of formulations of items between Scherer and Wallbott (1997) (SW), Smith and Ellsworth (1985) (SE), and our study.

| Dim.   | SW/SE  | crowd-enVENT   |
|--|--|--|
| <b>Relevance Detection: Novelty Check</b>          |  |  |
| Suddenness   | SW: At the time of experiencing the emotion, did you think that the event happened very suddenly and abruptly?   | The event was sudden or abrupt.  |
| Familiarity  | SW: At the time of experiencing the emotion, did you think that you were familiar with this type of event?   | The event was familiar.  |
| Event predictability                               | SW: At the time of experiencing the emotion, did you think that you could have predicted the occurrence of the event?  | I could have predicted the occurrence of the event.  |
| Attention, Attention removal                       | SE: Think about what was causing you to feel happy in this situation. When you were feeling happy, to what extent did you try to devote your attention to this thing, or divert your attention from it?  | I paid attention to the situation. I tried to shut the situation out of my mind.   |
| <b>Relevance Detection: Intrinsic Pleasantness</b> |  |  |
| Unpleasantness, Pleasantness                       | SW: How would you evaluate this type of event in general, independent of your specific needs and desires in the situation you reported above?<br>Pleasantness<br>Unpleasantness  | The event was pleasant for me.<br>The event was unpleasant for me.   |
| <b>Relevance Detection: Goal Relevance</b>         |  |  |
| Relevance  | SW: At the time of experiencing the emotion, did you think that the event would have very important consequences for you?  | I expected the event to have important consequences for me.  |
| <b>Implication Assessment: Causality: agent</b>    |  |  |
| Own, Others', Situational responsibility           | SW: At the time of the event, to what extent did you think that one or more of the following factors caused the event?<br>Your own behavior.<br>The behavior of one or more other person(s). Chance, special circumstances, or natural forces. | The event was caused by my own behavior.<br>The event was caused by somebody else's behavior.<br>The event was caused by chance, special circumstances, or natural forces. |

**Table 13**  
(continued)

| Dim.   | SW/SE   | crowd-enVENT   |
|--|---|--|
| <b>Implication Assessment: Goal Conduciveness</b>  |   |  |
| Goal support                                       | SW: At the time of experiencing the emotion, did you think that real or potential consequences of the event...<br>... did or would bring about positive, desirable outcomes for you (e.g., helping you to reach a goal, giving pleasure, or terminating an unpleasant situation)?<br>...did or would bring about negative, undesirable outcomes for you (e.g., preventing you from reaching a goal or satisfying a need, resulting in bodily harm, or producing unpleasant feelings)? | At that time I felt that the event had positive consequences for me.   |
| <b>Implication Assessment: Outcome Probability</b> |   |  |
| Consequence anticipation                           | SW: At the time of experiencing the emotion, did you think that the real or potential consequences of the event had already been felt by you or were completely predictable?  | At that time I anticipated the consequences of the event.  |
| <b>Implication Assessment: Urgency</b>             |   |  |
| Response urgency                                   | SW: After you had a good idea of what the probable consequences of the event would be, did you think that it was urgent to act immediately?   | The event required an immediate response.  |
| <b>Coping Potential: Control</b>                   |   |  |
| Own, Others', Chance control                       | SE: When you were feeling happy, to what extent did you feel that you had the ability to influence what was happening in this situation?<br>Someone other than yourself was controlling what was happening in this situation?<br>Circumstances beyond anyone's control were controlling what was happening in this situation?   | I had the capacity to affect what was going on during the event. Someone or something other than me was influencing what was going on during the situation.<br>The situation was the result of outside influences of which nobody had control. |
| <b>Coping Potential: Adjustment Check</b>          |   |  |
| Anticipated acceptance                             | SW: After you had a good idea of what the probable consequences of the event would be, did you think that you could live with, and adjust to, the consequences of the event that could not be avoided or modified?  | I anticipated that I could live with the unavoidable consequences of the event.  |
| Effort   | SE: When you were feeling happy, how much effort (mental or physical) did you feel this situation required you to expend?   | The situation required me to expend a great deal of energy to deal with it.  |

Downloaded from [http://direct.mit.edu/col/article-pdf/49/1/1/2068921/col\\_a\\_00461.pdf](http://direct.mit.edu/col/article-pdf/49/1/1/2068921/col_a_00461.pdf) by Otto-Friedrich-Universität Bamberg user on 18 July 2024

**Table 13**  
(continued)

| Dim.                                   | SW/SE  | crowd-enVENT  |
|--|--|---|
| <b>Normative Significance: Control</b> |  |   |
| Internal standards compatibility       | SW: At the time of experiencing the emotion, did you think that the actions that produced the event were morally and ethically acceptable? | The event clashed with my standards and ideals.     |
| External norms compatibility           | SW: At the time of experiencing the emotion, did you think that the actions that produced the event violated laws or social norms?         | The event violated laws or socially accepted norms. |

## A2. Study Details

Table 14 reports an overview of the participants and the cost involved in the generation of crowd-enVENT. For each round, we indicate the strategy used in the text production task:

- Strategy 0: Participants were free to write any event of their choice.
- Strategy 1: They were asked to recount an event special to their lives.
- Strategy 2: They were shown the list of topics to avoid (described in Section 4.2, Table 2).

The row “Workers” reports the number of different participants accepted in each round, hence in the column “ $\Sigma$ ” is the total number of (unique) annotators whose answers entered the corpus (with the exception of those who contributed to round 1\*, the pretest that we do not include in crowd-enVENT). Note that the same worker could participate in multiple rounds; for this reason the sum of workers across rounds exceeds 2,379.

Table 15 shows the same information for the validation phase.  $\Sigma = \text{£}1768.09$  refers to the cost prior to releasing the bonus: We rewarded an extra payment of £5 to the 60 best performing validators, amounting to £420 (i.e., £300 for the bonus in total + commission charges).

**Table 14**

Generation: Overview of study details, for each round separately (with the relative text variability induction strategies) and by aggregating them.

| Rounds     | 1*    | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | $\Sigma$ |         |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------|---------|
| Strategies | 0     | 0     | 0     | 1     | 2     | 1     | 2     | 2     | 2     | 2        |         |
| Workers    | –     | 111   | 526   | 476   | 846   | 349   | 81    | 13    | 15    | 2,379    |         |
| Cost (£)   | 156.1 | 154.7 | 870.1 | 571.2 | 552.3 | 917.8 | 858.2 | 616.7 | 102.9 | 10.5     | 4,825.2 |

**Table 15**

Validation: Overview of study details, per round and after aggregation.

| Rounds   | 1  | 2       | 3      | 4    | 5   | 6   | $\Sigma$ |
|----------|----|---------|--------|------|-----|-----|----------|
| Workers  | 20 | 1,048   | 120    | 25   | 3   | 1   | 1,217    |
| Cost (£) | 84 | 1,474.1 | 167.99 | 36.4 | 4.2 | 1.4 | 1,768.09 |

### A3. Details on the Data Collection Questionnaires

The questionnaires in the generation and the validation phases of building crowd-enVENT are formulated in a comparable manner. Table 16 makes the variants transparent to the reader, showing differences between the templates in two phases, and across the multiple rounds in the generation phase. Screenshots of the questionnaires as presented to the readers are available in the supplementary material, together with the corpus data.

Note that some workers skipped the demographics- and personality-related portion of the survey, which had to be completed for them to be rewarded. We allowed them to answer those questions in a separate form, containing only such questions. We include it in the supplementary material as well.

**Table 16**

Template of the Questionnaire. The first column specifies where the question has been asked.

*Gn*: Generation (*GE*: prompted by an emotion *E*, *GN*: prompted by the label “no emotion”) with text production strategy *n* (cf. Section A2.), *V*: Validation. No specification means that it has been asked in all variants. For the list of [OFF-LIMITS] topics in *n* = 2, refer to Table 2.

|    | Question/Text   | Value |
|----|---|-------|
| Gx | <p><b>Study on Emotional Events.</b> Dear participant, Thanks for your interest in this study. We aim at understanding your evaluation of events in which you either felt a particular emotion or did not feel any. Further, we will ask you some demographic and personality-related information. The study should take you 4 minutes, and you will be rewarded with £0.50. Your participation is voluntary. You have to be at least 18 years old and a native speaker of English. Feel free to quit at any time without giving a reason (note that you won't be paid in this case). You can take this survey multiple times. You are also welcome to participate to the other versions of the survey that we published on Prolific, in which we ask you for your experience with different emotions. Note that towards the end of this survey, you will find a small set of questions that you only need to answer the first time you participate (which will save you time if you'll work on the other survey variants). The data we collect via Google forms will be used for research purposes. It will be made publicly available in an anonymised form. We will further write a scientific paper publication about this study which can include examples from the collected data (also in anonymous form). Nevertheless, please avoid providing information that could identify you (such as names, contact details, etc.). This study is funded by the German Research Foundation (DFG, Project Number KL 2869/1-2). Principle Investigator of this study: Dr. Roman Klinger, University of Stuttgart (Germany). Responsible and contact person: Enrica Troiano, University of Stuttgart (Germany). For any information, contact us at <a href="mailto:enrica.troiano@ims.uni-stuttgart.de">enrica.troiano@ims.uni-stuttgart.de</a></p> | —     |

**Table 16**  
(continued)

|                 | Question/Text   | Value                        |
|-----------------|---|------------------------------|
| V               | <p><b>Study on Emotional Events.</b> Dear participant, Thanks for your interest in this study. In a previous survey, people described events that might have triggered a particular emotion in them, and they answered some questions about those events. We now ask you to evaluate such events. You will read 5 brief event descriptions. For each of them, you will be asked the same questions that were answered by the event experiencers in the previous survey. Your task is to answer the same way as they did. Participants who are able to answer most similarly to the original authors will get a bonus of £5. We reward this bonus to the best 5% of participants. We will also ask you some demographic and personality-related information. There, your task is to provide information about yourself, and not about the author of the texts. The study should take you 8 minutes, and you will be rewarded with £1. Your participation is voluntary. You have to be at least 18 years old and a native speaker of English. Feel free to quit at any time without giving a reason (note that you won't be paid in this case). The data we collect will be used for research purposes. It will be made publicly available in an anonymised form. We will further write a scientific paper publication about this study which can include examples from the collected data (also in anonymous form). This study is funded by the German Research Foundation (DFG, Project Number KL 2869/1-2). Principle Investigator of this study: Dr. Roman Klinger, University of Stuttgart (Germany). Responsible and contact person: Enrica Troiano, University of Stuttgart (Germany). For any information, contact us at <a href="mailto:enrica.troiano@ims.uni-stuttgart.de">enrica.troiano@ims.uni-stuttgart.de</a></p> | —                            |
|                 | I confirm that I have read the above information, meet the prerequisites for participation and want to participate in the study.  | Yes/No                       |
|                 | <p><b>Preliminary Questions.</b><br/>Please insert your ID as a worker on Prolific.<br/>Do you feel any of the following emotions right now, just before starting this survey? 1 means "not at all," 5 means "very intensely" [anger; boredom; disgust; fear; guilt; joy; pride; relief; sadness; shame; surprise; trust]</p>   | Text Matrix with items [1–5] |
| GE <sub>x</sub> | <p><b>This study is about the emotional experience of E.</b> You will be asked to describe a concrete situation or an event which provoked this feeling in you and for which you vividly remember both the circumstance and your reaction. After that, you will be asked further information regarding such emotional experience, by indicating how much you agree with some statements on a scale from 1 to 5. Note: If you participated in our studies before, please describe a different situation now. We cannot accept an answer related to the same event you already told us about, even if you used different words. Further, we will not accept answers if they are not descriptions of events, like "I can't remember" or "I do not have that feeling".</p>  | —                            |
| GN <sub>x</sub> | <p><b>This study is about an experience you had, which did not involve you emotionally.</b> You will be asked to describe a concrete situation or an event which did not provoke any particular feeling in you and for which you vividly remember both the circumstance and your reaction. After that, you will be asked further information regarding such experience, by indicating how much you agree with some statements on a scale from 1 to 5. Note: If you participated in our studies before, please describe a different situation now. We cannot accept an answer related to the same event you already told us about, even if you used different words. Further, we will not accept answers if they are not descriptions of events, like "I can't remember" or "I always have feelings".</p>  | —                            |

**Table 16**  
(continued)

|     | Question/Text  | Value         |
|-----|--|---------------|
| V   | <b>Put yourself in the shoes of other people.</b> You will read five texts. These texts describe events that occurred in the life of their authors. Don't be surprised if they are not perfectly grammatical, or if you find that some words are missing. For each event, you will assess if it provoked an emotion in the experiencer, and if so, what emotion that was. Moreover, you will be asked how you think the experiencer assessed the event: you will read some statements and indicate how much you agree with each of them on a scale from 1 to 5. The writers of these texts have answered these questions in a previous survey. Your goal now is to guess the answer given by the writers as closely as possible. | —             |
| GEx | <b>Recall an event that made you feel <i>E</i>.</b> Recall an event that made you feel <i>E</i> in the past.   | —             |
| GNx | <b>Recall an event that did not make you feel any emotion in the past.</b>   | —             |
|     | It could be an event of your choice, or one which you might have experienced in one of the following areas: health, career, finances, community, fun/leisure, sports, arts, personal relationships, travel, education, shopping, learning, food, nature, hobbies, work... Please describe the event by completing the sentence below, including event details or write multiple sentences if this helps to understand the situation.   | —             |
| G1  | The event should be special to you, or one which you think the other participants of this survey are unlikely to have experienced. It does not need to be an extraordinary event: it should just tell something about yourself.  | —             |
| G2  | NOTE: We already collected many answers related to [OFF-LIMITS]. Please recount an event which does not relate to any of these: we need events which are as diverse as possible!   | —             |
| GEx | Please complete the sentence: I felt <i>E</i> when/because/...   | Text          |
| GNx | Please complete the sentence: I felt NO PARTICULAR EMOTION when/because/...  | Text          |
| V   | What do you think the writer of the text felt when experiencing this event? [anger; boredom; disgust; fear; guilt; joy; pride; relief; sadness; shame; surprise; trust; no emotion]  | single choice |
| V   | How confident are you about your answer?   | 1...5         |
| Gx  | How long did the event last? [seconds; minutes; hours; days; weeks]  | single choice |
| V   | How long do you think the event lasted? [seconds; minutes; hours; days; weeks]   | single choice |
| GEx | How long did the emotion last? [seconds; minutes; hours; days; weeks]  | single choice |
| GNx | How long did the emotion last (if you had any)? [seconds; minutes; hours; days; weeks; I had none]   | single choice |
| V   | How long do you think the emotion lasted (if the experiencer had any)? [seconds; minutes; hours; days; weeks; this event did not cause any emotion]  | single choice |
| Gx  | How intense was your experience of the event?  | 1...5         |
| V   | How intense do you think the emotion was?  | 1...5         |
| Gx  | How confident are you that you recall the event well?  | 1...5         |
| Gx  | <b>Evaluation of that experience.</b> Think back to when the event happened and recall its details. Take some time to remember it properly. How much do these statements apply? (1 means "Not at all" and 5 means "Extremely")   | —             |

**Table 16**  
(continued)

|    | Question/Text  | Value |
|----|--|-------|
| V  | <b>Evaluation of that Experience.</b> Put yourself in the shoes of the writer at the time when the event happened, and try to reconstruct how that event was perceived. How much do these statements apply? (1 means "I don't agree at all" and 5 means "I completely agree")  |       |
|    | The event was sudden or abrupt.  | 1...5 |
| Gx | The event was familiar.  | 1...5 |
| V  | The event was familiar to its experienter.   | 1...5 |
| Gx | I could have predicted the occurrence of the event.  | 1...5 |
| V  | The experienter could have predicted the occurrence of the event.  | 1...5 |
| Gx | The event was pleasant for me.   | 1...5 |
| V  | The event was pleasant for the experienter.  | 1...5 |
| Gx | The event was unpleasant for me.   | 1...5 |
| V  | The event was unpleasant for the experienter.  | 1...5 |
| Gx | I expected the event to have important consequences for me.  | 1...5 |
| V  | The experienter expected the event to have important consequences for him/herself.   | 1...5 |
|    | The event was caused by chance, special circumstances, or natural forces.  | 1...5 |
| Gx | The event was caused by my own behavior.   | 1...5 |
| V  | The event was caused by the experienter's own behavior.  | 1...5 |
|    | The event was caused by somebody else's behavior.  | 1...5 |
| Gx | I anticipated the consequences of the event.   | 1...5 |
| V  | The experienter anticipated the consequences of the event.   | 1...5 |
| Gx | I expected positive consequences for me.   | 1...5 |
| V  | The experienter expected positive consequences for her/himself.  | 1...5 |
|    | The event required an immediate response.  | 1...5 |
| Gx | I was able to influence what was going on during the event.  | 1...5 |
| V  | The experienter was able to influence what was going on during the event.  | 1...5 |
| Gx | Someone other than me was influencing what was going on.   | 1...5 |
| V  | Someone other than the experienter was influencing what was going on.  | 1...5 |
|    | The situation was the result of outside influences of which nobody had control.  | 1...5 |
| Gx | I anticipated that I would easily live with the unavoidable consequences of the event.   | 1...5 |
| V  | The experienter anticipated that he/she could live with the unavoidable consequences of the event.   | 1...5 |
| Gx | The event clashed with my standards and ideals.  | 1...5 |
| V  | The event clashed with her/his standards and ideals.   | 1...5 |
|    | The actions that produced the event violated laws or socially accepted norms.  | 1...5 |
| Gx | I had to pay attention to the situation.   | 1...5 |
| V  | The experienter had to pay attention to the situation.   | 1...5 |
| Gx | I tried to shut the situation out of my mind.  | 1...5 |
| V  | The experienter wanted to shut the situation out of her/his mind.  | 1...5 |
| Gx | The situation required me a great deal of energy to deal with it.  | 1...5 |
| V  | The situation required her/him a great deal of energy to deal with it.   | 1...5 |
| V  | <b>Have you ever experienced an event similar to the one described?</b>  |       |
|    | I experienced a similar event before.  | 1...5 |
| Gx | <b>Is this the first time you participate in one of our emotional-event recollection studies?</b> We would like to know a bit more about you now. We have multiple similar studies on Prolific, all called "Recollection of an emotion-inducing experience," with the word "emotion" being replaced by an actual emotion name. When you participate in more than one of these studies, you only need to answer the following questions once. If this is the first time you participate, please |       |

**Table 16**  
(continued)

|    | Question/Text   | Value  |
|----|---|--|
|    | answer them (otherwise we won't be able to approve your contribution), later you will skip this step. [Yes, first time, I will answer the following questions.; No, I participated before and answered the next set of questions.]  | single choice  |
| V  | <b>Is this the first time you participate in our event evaluation studies?</b> If yes, you need to answer the following questions (otherwise we won't be able to approve your contribution). If no, you can skip them. [Yes, first time, I will answer the following questions.; No, I participated before and answered the next set of questions.]   | single choice  |
| Gx | <b>Demographic and Personality-related Questions.</b> As a last step, we ask you to answer some questions about yourself. Note: if you take one of our studies in the future, you won't fill in these sections again; if this is your first time and don't provide such information, we won't be able to reward you.<br>How old are you?<br>With which gender do you identify? [Female; Male; Gender Variant/ Non-Conforming; Prefer not to answer]<br>What is the highest level of education you completed? [No formal qualifications; Secondary education; High school; Undergraduate degree (BA/BSc/other); Graduate degree (MA/MSc/MPhil/other); Doctorate degree (PhD/other); Don't know/ not applicable]<br>With which of the following ethnic groups do you identify the most? [Australian/New Zealander; North Asian; South Asian; East Asian; Middle Eastern; European; African; North American; South American; Hispanic/Latino; Indigenous; Prefer not to answer; Other...]<br>Here are a number of personality traits that may or may not apply to you. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other. [Extraverted, enthusiastic; Critical, quarrelsome; Dependable, self-disciplined; Anxious, easily upset; Open to new experiences, complex; Reserved, quiet; Sympathetic, warm; Disorganized, careless; Calm, emotionally stable; Conventional, uncreative] | —<br><br>{ }<br>single choice<br>single choice<br>single choice<br>Matrix with items [1...7] |
| Gx | <b>One Last Question.</b> Please be assured that your answer will in no way influence how we treat your submission (you will be rewarded, if you properly followed our instructions). Did you actually experience that event or did you make it up to? [The event really happened in my life.; I never experienced that event, but I really imagined how it would make me feel.]  | single choice  |

Downloaded from [http://direct.mit.edu/colll/article-pdf/49/1/1/2068921/colli\\_a\\_00461.pdf](http://direct.mit.edu/colll/article-pdf/49/1/1/2068921/colli_a_00461.pdf) by Otto-Friedrich-Universität Bamberg user on 18 July 2024

#### A4. Details on Results

Our modeling results for the task of predicting appraisals are averages across 5 runs of the model. In tables 17, 18, and 19, we complement such results with standard deviation values.

**Table 17**

Appraisal prediction performance of text classifiers and regressors ( $T \rightarrow A_{\text{model}}$ ) as  $F_1$  and RMSE.

| Appraisal          | Classification             |                            | Regression                 |                            |
|--------------------|----------------------------|----------------------------|----------------------------|----------------------------|
|                    | $T \rightarrow A$<br>human | $T \rightarrow A$<br>model | $T \rightarrow A$<br>human | $T \rightarrow A$<br>model |
|                    | $F_1$                      | $F_1$                      | RMSE                       | RMSE                       |
| Suddenness         | .68                        | .74 $\pm$ .02              | 1.47                       | 1.33 $\pm$ .05             |
| Familiarity        | .53                        | .79 $\pm$ .00              | 1.49                       | 1.42 $\pm$ .09             |
| Event Pred.        | .56                        | .75 $\pm$ .01              | 1.46                       | 1.47 $\pm$ .17             |
| Pleasantness       | .83                        | .88 $\pm$ .01              | 1.10                       | 1.30 $\pm$ .06             |
| Unpleasantness     | .85                        | .80 $\pm$ .01              | 1.22                       | 1.26 $\pm$ .05             |
| Goal Relevance     | .66                        | .71 $\pm$ .01              | 1.52                       | 1.57 $\pm$ .17             |
| Situat. Resp.      | .48                        | .85 $\pm$ .01              | 1.55                       | 1.43 $\pm$ .09             |
| Own Resp.          | .73                        | .79 $\pm$ .01              | 1.32                       | 1.40 $\pm$ .11             |
| Others' Resp.      | .74                        | .73 $\pm$ .02              | 1.54                       | 1.57 $\pm$ .24             |
| Anticip. Conseq.   | .52                        | .69 $\pm$ .02              | 1.61                       | 1.50 $\pm$ .11             |
| Goal Support       | .67                        | .81 $\pm$ .01              | 1.36                       | 1.33 $\pm$ .12             |
| Urgency            | .54                        | .61 $\pm$ .03              | 1.68                       | 1.43 $\pm$ .05             |
| Own Control        | .53                        | .79 $\pm$ .01              | 1.48                       | 1.35 $\pm$ .08             |
| Others' Control    | .76                        | .62 $\pm$ .01              | 1.55                       | 1.36 $\pm$ .07             |
| Situat. Control    | .51                        | .87 $\pm$ .01              | 1.53                       | 1.35 $\pm$ .06             |
| Accept. Conseq.    | .43                        | .64 $\pm$ .02              | 1.77                       | 1.44 $\pm$ .06             |
| Internal Standards | .57                        | .82 $\pm$ .01              | 1.44                       | 1.36 $\pm$ .09             |
| External Norms     | .56                        | .92 $\pm$ .00              | 1.16                       | 1.34 $\pm$ .15             |
| Attention          | .74                        | .48 $\pm$ .04              | 1.38                       | 1.27 $\pm$ .07             |
| Not Consider       | .54                        | .77 $\pm$ .03              | 1.56                       | 1.53 $\pm$ .13             |
| Effort             | .61                        | .70 $\pm$ .03              | 1.47                       | 1.38 $\pm$ .06             |
| Average            | .62                        | .75 $\pm$ .00              | 1.46                       | 1.40 $\pm$ .10             |

**Table 18**

Emotion prediction performance of classifiers using appraisals as input ( $A^{Gold} \rightarrow E_{model}$ ,  $A^{Pred} \rightarrow E_{model}$ ).

| Emotion    | Discretized (1)                  |                                  | Scaled (2)                       |                                  |
|------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
|            | $A^{Gold}_{model} \rightarrow E$ | $A^{Pred}_{model} \rightarrow E$ | $A^{Gold}_{model} \rightarrow E$ | $A^{Pred}_{model} \rightarrow E$ |
|            | F <sub>1</sub>                   | F <sub>1</sub>                   | F <sub>1</sub>                   | F <sub>1</sub>                   |
| Anger      | .37 ± .04                        | .32 ± .04                        | .37 ± .01                        | .37 ± .01                        |
| Boredom    | .46 ± .02                        | .60 ± .02                        | .54 ± .01                        | .52 ± .01                        |
| Disgust    | .36 ± .03                        | .37 ± .03                        | .45 ± .01                        | .29 ± .01                        |
| Fear       | .26 ± .03                        | .32 ± .03                        | .30 ± .01                        | .36 ± .01                        |
| Guilt      | .23 ± .03                        | .19 ± .03                        | .30 ± .04                        | .18 ± .04                        |
| Joy        | .30 ± .05                        | .30 ± .05                        | .32 ± .04                        | .25 ± .04                        |
| No emotion | .46 ± .03                        | .35 ± .03                        | .46 ± .02                        | .31 ± .02                        |
| Pride      | .35 ± .05                        | .36 ± .05                        | .33 ± .05                        | .28 ± .05                        |
| Relief     | .18 ± .04                        | .19 ± .04                        | .21 ± .04                        | .27 ± .04                        |
| Sadness    | .29 ± .05                        | .34 ± .05                        | .34 ± .03                        | .32 ± .03                        |
| Shame      | .18 ± .04                        | .24 ± .04                        | .24 ± .04                        | .31 ± .04                        |
| Surprise   | .44 ± .03                        | .44 ± .03                        | .41 ± .02                        | .28 ± .02                        |
| Trust      | .24 ± .02                        | .15 ± .02                        | .21 ± .06                        | .27 ± .06                        |
| Macro avg. | .31 ± .01                        | .32 ± .01                        | .35 ± .02                        | .31 ± .02                        |

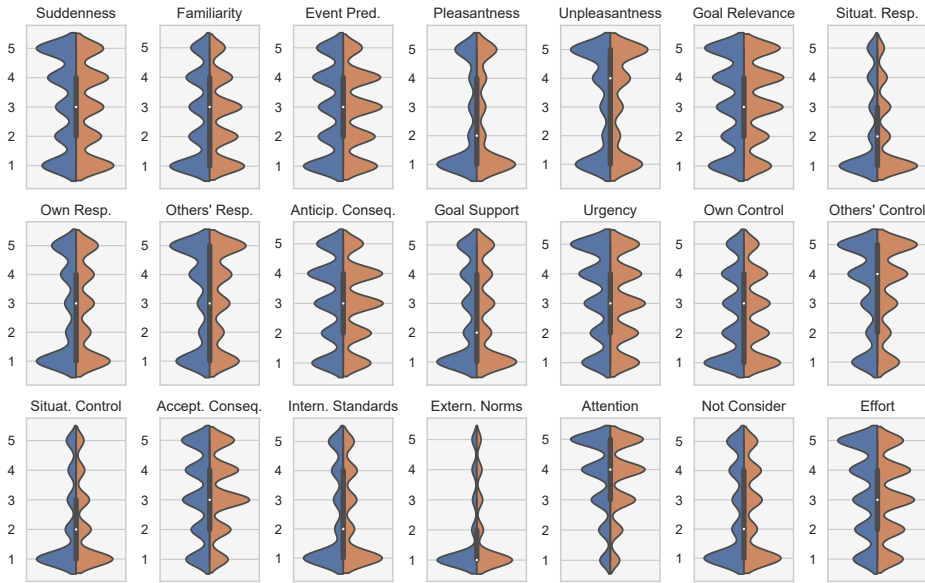
**Table 19**

Emotion prediction performance of appraisal-aware text classifiers ( $T \rightarrow E_{model}$ ,  $TA^{Gold} \rightarrow E_{model}$ ,  $TA^{Pred} \rightarrow E_{model}$ ).

| Emotion    | $T \rightarrow E_{human}$ | $T \rightarrow E_{model}$ | $TA^{Gold}_{model} \rightarrow E$ | $TA^{Pred}_{model} \rightarrow E$ |
|------------|---------------------------|---------------------------|-----------------------------------|-----------------------------------|
|            | F <sub>1</sub>            | F <sub>1</sub>            | F <sub>1</sub>                    | F <sub>1</sub>                    |
| Anger      | .57                       | .53 ± .05                 | .57 ± .02                         | .57 ± .02                         |
| Boredom    | .73                       | .84 ± .01                 | .83 ± .03                         | .83 ± .03                         |
| Disgust    | .65                       | .66 ± .00                 | .66 ± .04                         | .66 ± .04                         |
| Fear       | .73                       | .65 ± .03                 | .67 ± .04                         | .67 ± .03                         |
| Guilt      | .53                       | .48 ± .06                 | .58 ± .05                         | .56 ± .07                         |
| Joy        | .49                       | .45 ± .02                 | .48 ± .03                         | .47 ± .03                         |
| No emotion | .33                       | .55 ± .01                 | .56 ± .02                         | .56 ± .01                         |
| Pride      | .59                       | .54 ± .03                 | .55 ± .01                         | .55 ± .01                         |
| Relief     | .64                       | .63 ± .02                 | .62 ± .01                         | .62 ± .02                         |
| Sadness    | .63                       | .59 ± .03                 | .65 ± .01                         | .63 ± .00                         |
| Shame      | .48                       | .51 ± .01                 | .50 ± .08                         | .49 ± .07                         |
| Surprise   | .42                       | .53 ± .02                 | .49 ± .03                         | .50 ± .02                         |
| Trust      | .52                       | .74 ± .02                 | .73 ± .04                         | .72 ± .03                         |
| Macro avg. | .56                       | .59 ± .01                 | .61 ± .02                         | .60 ± .02                         |

## A5. Appraisal Labels across Generation and Validation

Figure 13 shows the distributions of the 21 appraisal variables. The width of a curve visualizes the relative frequency of the 5 values for the label in question. The left side (blue) of each plot represents the generation phase and the right part (orange) corresponds to the validation-based annotations.



**Figure 13** Distributions of appraisal ratings from the two phases of corpus constructions (blue: generation, orange: validation).

### Acknowledgments

We thank Kai Sassenberg for support with the formulation of the items in the questionnaires and general consultation in the area of emotion theories. This research is funded by the German Research Council (DFG), project “Computational Event Analysis based on Appraisal Theories for Emotion Analysis” (CEAT, project number KL 2869/1-2).

### References

Abdul-Mageed, Muhammad and Lyle Ungar. 2017. EmoNet: Fine-grained emotion detection with gated recurrent neural networks. In *Proceedings of the 55th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 718–728. <https://doi.org/10.18653/v1/P17-1067>

Adolphs, Ralph. 2017. How should neuroscience study emotions? By distinguishing emotion states, concepts, and experiences. *Social Cognitive and Affective Neuroscience*, 12(1):24–31. <https://doi.org/10.1093/scan/nsw153>, PubMed: 27798256

Akhtar, Shad, Deepanway Ghosal, Asif Ekbal, Pushpak Bhattacharyya, and Sadao Kurohashi. 2019. All-in-one: Emotion, sentiment and intensity prediction using a multi-task ensemble framework. *IEEE Transactions on Affective Computing*, pages 285–297.

Alm, Cecilia Ovesdotter, Dan Roth, and Richard Sproat. 2005. Emotions from text: Machine learning for text-based emotion prediction. In *Proceedings of Human Language Technology Conference and Conference on Empirical Methods in Natural Language Processing*, pages 579–586. <https://doi.org/10.3115/1220575.1220648>

- Aman, Saima and Stan Szpakowicz. 2007. Identifying expressions of emotion in text. In *Text, Speech and Dialogue*, pages 196–205, Springer, Berlin Heidelberg.
- Balahur, Alexandra, Jesus M. Hermida, and Andres Montoyo. 2011. Building and exploiting EmotiNet, a knowledge base for emotion detection based on the appraisal theory model. *IEEE Transactions on Affective Computing*, 3(1):88–101. <https://doi.org/10.1109/T-AFFC.2011.33>
- Balahur, Alexandra, Jesus M. Hermida, and Andrew Montoyo. 2012. Building and exploiting EmotiNet, a knowledge base for emotion detection based on the appraisal theory model. *IEEE Transactions on Affective Computing*, 3(1):88–101. <https://doi.org/10.1109/T-AFFC.2011.33>
- Bostan, Laura Ana Maria, Evgeny Kim, and Roman Klinger. 2020. GoodNewsEveryone: A corpus of news headlines annotated with emotions, semantic roles, and reader perception. In *Proceedings of the 12th International Conference on Language Resources and Evaluation (LREC'20)*.
- Bostan, Laura Ana Maria and Roman Klinger. 2018. An analysis of annotated corpora for emotion classification in text. In *Proceedings of the 27th International Conference on Computational Linguistics*, pages 2104–2119.
- Bradley, Margaret M. and Peter J. Lang. 1994. Measuring emotion: The Self-Assessment Manikin and the Semantic Differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(1):49–59. [https://doi.org/10.1016/0005-7916\(94\)90063-9](https://doi.org/10.1016/0005-7916(94)90063-9)
- Bradley, Margaret M. and Peter J. Lang. 1999. Affective norms for English words (anew): Instruction manual and affective ratings, Technical report C-1, the Center for Research in Psychophysiology, University of Florida, Gainesville, Florida, USA.
- Breazeal, Cynthia, Kerstin Dautenhahn, and Takayuki Kanda. 2016. Social robotics. *Springer Handbook of Robotics*. Springer International Publishing, Cham, pages 1935–1972. [https://doi.org/10.1007/978-3-319-32552-1\\_72](https://doi.org/10.1007/978-3-319-32552-1_72)
- Buechel, Sven and Udo Hahn. 2016. Emotion analysis as a regression problem—dimensional models and their implications on emotion representation and metrical evaluation. *ECAI 2016*, pages 1114–1122.
- Buechel, Sven and Udo Hahn. 2017a. EmoBank: Studying the impact of annotation perspective and representation format on dimensional emotion analysis. In *Proceedings of the 15th Conference of the European Chapter of the Association for Computational Linguistics: Volume 2, Short Papers*, pages 578–585. <https://doi.org/10.18653/v1/E17-2092>
- Buechel, Sven and Udo Hahn. 2017b. Readers vs. writers vs. texts: Coping with different perspectives of text understanding in emotion annotation. In *Proceedings of the 11th Linguistic Annotation Workshop*, pages 1–12. <https://doi.org/10.18653/v1/W17-0801>
- Buechel, Sven, Johannes Hellrich, and Udo Hahn. 2016. Feelings from the Past—Adapting affective lexicons for historical emotion analysis. In *Proceedings of the Workshop on Language Technology Resources and Tools for Digital Humanities (LT4DH)*, pages 54–61.
- Buechel, Sven, Luise Modersohn, and Udo Hahn. 2021. Towards label-agnostic emotion embeddings. In *Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing*, pages 9231–9249. <https://doi.org/10.18653/v1/2021.emnlp-main.728>
- Buechel, Sven, Susanna Rücker, and Udo Hahn. 2020. Learning and evaluating emotion lexicons for 91 languages. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, pages 1202–1217.
- Canty, Angelo and B. D. Ripley. 2021. *boot: Bootstrap R (S-Plus) Functions*. R package version 1.3-28.
- Casel, Felix, Amelie Heindl, and Roman Klinger. 2021. Emotion recognition under consideration of the emotion component process model. In *Proceedings of the 17th Conference on Natural Language Processing (KONVENS 2021)*, pages 49–61.
- Cheng, Yu-Ya, Wen-Chao Yeh, Yan-Ming Chen, and Yung-Chun Chang. 2021. Using valence and arousal-infused Bi-LSTM for sentiment analysis in social media product reviews. In *Proceedings of the 33rd Conference on Computational Linguistics and Speech Processing (ROCLING 2021)*, pages 210–217.
- Clark, Elizabeth A., J’Nai Kessinger, Susan E. Duncan, Martha Ann Bell, Jacob Lahne, Daniel L. Gallagher, and Sean F. O’Keefe. 2020. The facial action coding system for characterization of human affective response to consumer product-based stimuli: A systematic review. *Frontiers in Psychology*, Article 920. <https://doi.org/10.3389/fpsyg.2020.00920>, PubMed: 32528361

- Clore, Gerald. L. and Andrew Ortony. 2013. Psychological construction in the OCC model of emotion. *Emotion Review*, 5(4):335–343. <https://doi.org/10.1177/1754073913489751>, PubMed: 25431620
- Cohen, Jacob. 1960. A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, 20(1):37–46. <https://doi.org/10.1177/001316446002000104>
- Dalili, M. N., I. S. Penton-Voak, C. J. Harmer, and M. R. Munafò. 2015. Meta-analysis of emotion recognition deficits in major depressive disorder. *Psychological Medicine*, 45(6):1135–1144. <https://doi.org/10.1017/S0033291714002591>, PubMed: 25395075
- Darwin, Charles. 1872. *The Expression of the Emotions in Man and Animals*. John Murray. <https://doi.org/10.1037/10001-000>
- Davison, Anthony C. and David V. Hinkley. 1997. *Bootstrap Methods and Their Applications*. Cambridge University Press, Cambridge.
- De Bruyne, Luna, Orphée De Clercq, and Véronique Hoste. 2021. Prospects for Dutch emotion detection: Insights from the new emotion dataset. *Computational Linguistics in the Netherlands Journal*, 11:231–255.
- Demszky, Dorottya, Dana Movshovitz-Attias, Jeongwoo Ko, Alan Cowen, Gaurav Nemade, and Sujith Ravi. 2020. GoEmotions: A dataset of fine-grained emotions. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, pages 4040–4054. <https://doi.org/10.18653/v1/2020.acl-main.372>
- Dixon, Thomas. 2012. “Emotion”: The history of a keyword in crisis. *Emotion Review*, 4(4):338–344. <https://doi.org/10.1177/1754073912445814>, PubMed: 23459790
- Döllinger, Lillian, Petri Laukka, Lennart Björn Högman, Tanja Bänziger, Irena Makower, Håkan Fischer, and Stephan Hau. 2021. Training emotion recognition accuracy: Results for multimodal expressions and facial micro expressions. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.708867>, PubMed: 34475841
- Dunn, Jennifer R. and Maurice E. Schweitzer. 2005. Feeling and believing: The influence of emotion on trust. *Journal of Personality and Social Psychology*, 88(5):736. <https://doi.org/10.1037/0022-3514.88.5.736>, PubMed: 15898872
- Ekman, Paul. 1972. Universals and cultural differences in facial expressions of emotion. In *Nebraska Symposium on Motivation 1971*, volume 19, Lincoln University of Nebraska Press.
- Ekman, Paul. 1992. An argument for basic emotions. *Cognition & Emotion*, 6(3–4):169–200. <https://doi.org/10.1080/02699939208411068>
- Ekman, Paul and Wallace V. Friesen. 1978. *Facial Action Coding System: A Technique for the Measurement of Facial Movement*. Consulting Psychologists Press, Palo Alto, CA. <https://doi.org/10.1037/t27734-000>
- Ekman, Paul, Wallace V. Friesen, and Sonia Ancoli. 1980. Facial signs of emotional experience. *Journal of Personality and Social Psychology*, 39(6):1125–1134. <https://doi.org/10.1037/h0077722>
- Ellsworth, Phoebe C. and Craig A. Smith. 1988. From appraisal to emotion: Differences among unpleasant feelings. *Motivation and Emotion*, 12(3):271–302. <https://doi.org/10.1007/BF00993115>
- Felbo, Bjarke, Alan Mislove, Anders Søgaard, Iyad Rahwan, and Sune Lehmann. 2017. Using millions of emoji occurrences to learn any-domain representations for detecting sentiment, emotion and sarcasm. In *Proceedings of the 2017 Conference on Empirical Methods in Natural Language Processing*, pages 1615–1625.
- Feldman Barrett, Lisa. 2017. The theory of constructed emotion: An active inference account of interoception and categorization. *Social Cognitive and Affective Neuroscience*, 12(11):1833. <https://doi.org/10.1093/scan/nsx060>, PubMed: 28472391
- Feldman Barrett, Lisa. 2018. *How Emotions Are Made: The Secret Life of the Brain*. HMH Books.
- Frijda, Nico H., Peter Kuipers, and Elisabeth Ter Schure. 1989. Relations among emotion, appraisal, and emotional action readiness. *Journal of Personality and Social Psychology*, 57(2):212. <https://doi.org/10.1037/0022-3514.57.2.212>
- Gardner, Matt, Joel Grus, Mark Neumann, Oyvind Tafjord, Pradeep Dasigi, Nelson F. Liu, Matthew Peters, Michael Schmitz, and Luke Zettlemoyer. 2018. AllenNLP: A deep semantic natural language processing platform. In *Proceedings of Workshop for NLP Open Source Software (NLP-OSS)*, pages 1–6. <https://doi.org/10.18653/v1/W18-2501>
- Gosling, Samuel D., Peter J. Rentfrow, and William B. Swann Jr. 2003. A very brief

- measure of the big-five personality domains. *Journal of Research in Personality*, 37(6):504–528. [https://doi.org/10.1016/S0092-6566\(03\)00046-1](https://doi.org/10.1016/S0092-6566(03)00046-1)
- Gratch, Jonathan, Stacy Marsella, Ning Wang, and Brooke Stankovic. 2009. Assessing the validity of appraisal-based models of emotion. In *2009 3rd International Conference on Affective Computing and Intelligent Interaction and Workshops*, pages 1–8.
- Haider, Thomas, Steffen Eger, Evgeny Kim, Roman Klinger, and Winfried Menninghaus. 2020. PO-EMO: Conceptualization, annotation, and modeling of aesthetic emotions in German and English poetry. In *Proceedings of the 12th Language Resources and Evaluation Conference*, pages 1652–1663.
- Hall, Judith A., Marianne Schmid Mast, and Tessa V. West. 2016. Accurate interpersonal perception: Many traditions, one topic. In *The Social Psychology of Perceiving Others Accurately*. Cambridge University Press, pages 3–22. <https://doi.org/10.1017/CB09781316181959.001>
- Hofmann, Jan, Enrica Troiano, and Roman Klinger. 2021. Emotion-aware, emotion-agnostic, or automatic: Corpus creation strategies to obtain cognitive event appraisal annotations. In *Proceedings of the Eleventh Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis*, pages 160–170.
- Hofmann, Jan, Enrica Troiano, Kai Sassenberg, and Roman Klinger. 2020. Appraisal theories for emotion classification in text. In *Proceedings of the 28th International Conference on Computational Linguistics*, pages 125–138. <https://doi.org/10.18653/v1/2020.coling-main.11>
- Israel, Laura Sophia Finja and Felix D. Schönbrodt. 2019. Emotion prediction with weighted appraisal models—Validating a psychological theory of affect. *IEEE Transactions on Affective Computing*, 13:604–615.
- Jacobs, Gilles and Véronique Hoste. 2021. Fine-grained implicit sentiment in financial news: Uncovering hidden bulls and bears. *Electronics*, 10(20):2554. <https://doi.org/10.3390/electronics10202554>
- Jacobs, Gilles and Véronique Hoste. 2022. SENTiVENT: Enabling supervised information extraction of company-specific events in economic and financial news. *Language Resources and Evaluation*, 56(1):225–257. <https://doi.org/10.1007/s10579-021-09562-4>
- James, William. 1894. Discussion: The physical basis of emotion. *Psychological Review*, 1(5):516–529. <https://doi.org/10.1037/h0065078>
- Karg, Michelle, Ali-Akbar Samadani, Rob Gorbet, Kolja Kühnlenz, Jesse Hoey, and Dana Kulić. 2013. Body movements for affective expression: A survey of automatic recognition and generation. *IEEE Transactions on Affective Computing*, 4(4):341–359. <https://doi.org/10.1109/T-AFFC.2013.29>
- Kim, Evgeny and Roman Klinger. 2018. Who feels what and why? Annotation of a literature corpus with semantic roles of emotions. In *Proceedings of the 27th International Conference on Computational Linguistics*, pages 1345–1359.
- Kim, Hyoung Rock and Dong-Soo Kwon. 2010. Computational model of emotion generation for human–robot interaction based on the cognitive appraisal theory. *Journal of Intelligent & Robotic Systems*, 60(2):263–283. <https://doi.org/10.1007/s10846-010-9418-7>
- Klinger, Roman, Orphée De Clercq, Saif Mohammad, and Alexandra Balahur. 2018. IEST: WASSA-2018 implicit emotions shared task. In *Proceedings of the 9th Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis*, pages 31–42. <https://doi.org/10.18653/v1/W18-6206>
- Köper, Maximilian, Evgeny Kim, and Roman Klinger. 2017. IMS at EmoInt-2017: Emotion intensity prediction with affective norms, automatically extended resources and deep learning. In *Proceedings of the 8th Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis*, pages 50–57. <https://doi.org/10.18653/v1/W17-5206>
- Lewis, Marc D. 2001. Personal pathways in the development of appraisal. *Appraisal processes in emotion: Theory, methods, research*, pages 205–220.
- Li, Yanran, Hui Su, Xiaoyu Shen, Wenjie Li, Ziqiang Cao, and Shuzi Niu. 2017. DailyDialog: A manually labelled multi-turn dialogue dataset. In *Proceedings of the Eighth International Joint Conference on Natural Language Processing (Volume 1: Long Papers)*, pages 986–995.
- Liu, Bing. 2012. Sentiment analysis and opinion mining. *Synthesis Lectures on*

- Human Language Technologies*, 5(1):1–167. [https://doi.org/10.1007/978-3-031-02145-9\\_1](https://doi.org/10.1007/978-3-031-02145-9_1), <https://doi.org/10.1007/978-3-031-02145-9>
- Liu, Yinhan, Myle Ott, Naman Goyal, Jingfei Du, Mandar Joshi, Danqi Chen, Omer Levy, Mike Lewis, Luke Zettlemoyer, and Veselin Stoyanov. 2019. RoBERTa: A robustly optimized BERT pretraining approach. arXiv:1907.11692. <https://arxiv.org/abs/1907.11692>.
- Louviere, Jordan J., Terry N. Flynn, and A. A. J. Marley. 2015. *Best-Worst Scaling: Theory, Methods and Applications*. Cambridge University Press. <https://doi.org/10.1017/CB09781107337855>
- Mancini, Giacomo, Roberta Biolcati, Sergio Agnoli, Federica Andrei, and Elena Trombini. 2018. Recognition of facial emotional expressions among Italian pre-adolescents, and their affective reactions. *Frontiers in Psychology*, 9.
- Manstead, A. S. R. and Philip E. Tetlock. 1989. Cognitive appraisals and emotional experience: Further evidence. *Cognition and Emotion*, 3(3):225–240. <https://doi.org/10.1080/02699938908415243>
- Mihalcea, Rada and Carlo Strapparava. 2012. Lyrics, music, and emotions. In *Proceedings of the 2012 Joint Conference on Empirical Methods in Natural Language Processing and Computational Natural Language Learning*, pages 590–599.
- Mohammad, Saif. 2012. #emotional tweets. In *\*SEM 2012: The First Joint Conference on Lexical and Computational Semantics – Volume 1: Proceedings of the Main Conference and the Shared Task, and Volume 2: Proceedings of the Sixth International Workshop on Semantic Evaluation (SemEval 2012)*, pages 246–255.
- Mohammad, Saif. 2018. Obtaining reliable human ratings of valence, arousal, and dominance for 20,000 English words. In *Proceedings of the 56th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, pages 174–184. <https://doi.org/10.18653/v1/P18-1017>
- Mohammad, Saif, Felipe Bravo-Marquez, Mohammad Salameh, and Svetlana Kiritchenko. 2018. SemEval-2018 Task 1: Affect in tweets. In *Proceedings of The 12th International Workshop on Semantic Evaluation*, pages 1–17. <https://doi.org/10.18653/v1/S18-1001>
- Mohammad, Saif, Xiaodan Zhu, and Joel Martin. 2014. Semantic role labeling of emotions in tweets. In *Proceedings of the 5th Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis*, pages 32–41. <https://doi.org/10.3115/v1/W14-2607>
- Mohammad, Saif M. 2022. Ethics sheet for automatic emotion recognition and sentiment analysis. *Computational Linguistics*, 48(2):239–278. [https://doi.org/10.1162/coli\\_a\\_00433](https://doi.org/10.1162/coli_a_00433)
- Mohammad, Saif M. and Peter D. Turney. 2012. Crowdsourcing a word-emotion association lexicon. *Computational Intelligence*, 29(3):437–465. <https://doi.org/10.1111/j.1467-8640.2012.00460.x>
- Mukherjee, Rajdeep, Atharva Naik, Sriyash Poddar, Soham Dasgupta, and Niloy Ganguly. 2021. Understanding the role of affect dimensions in detecting emotions from tweets: A multi-task approach. In *Proceedings of the 44th International ACM SIGIR Conference on Research and Development in Information Retrieval*, pages 2303–2307. <https://doi.org/10.1145/3404835.3463080>
- Musat, Claudiu and Stefan Trausan-Matu. 2010. The impact of valence shifters on mining implicit economic opinions. In *International Conference on Artificial Intelligence: Methodology, Systems, and Applications*, pages 131–140. [https://doi.org/10.1007/978-3-642-15431-7\\_14](https://doi.org/10.1007/978-3-642-15431-7_14)
- Myers, Gerald E. 1969. William James’s theory of emotion. *Transactions of the Charles S. Peirce Society*, 5(2):67–89.
- Nair, Vinod and Geoffrey E. Hinton. 2010. Rectified linear units improve restricted Boltzmann machines. In *Proceedings of the 27th International Conference on Machine Learning (ICML-10)*, pages 807–814.
- Oatley, Keith and Philip N. Johnson-Laird. 2014. Cognitive approaches to emotions. *Trends in Cognitive Sciences*, 18(3):134–140. <https://doi.org/10.1016/j.tics.2013.12.004>, PubMed: 24389368
- Omdahl, Becky Lynn. 1995. *Cognitive Appraisal, Emotion, and Empathy*. Mahwah, NJ: Lawrence Erlbaum.
- Park, Sungjoon, Jiseon Kim, Seonghyeon Ye, Jaeyoul Jeon, Hee Young Park, and Alice Oh. 2021. Dimensional emotion detection from categorical emotion. In *Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing*, pages 4367–4380.
- Pennebaker, James W., Martha E. Francis, and Roger J. Booth. 2001. Linguistic inquiry and word count: LIWC 2001. Mahwah, NJ: Lawrence Erlbaum Associates, 71:2001.

- Plutchik, Robert. 1970. Emotions, evolution and adaptive processes. In Arnold, M. B., editor, *Feelings and Emotions*. New York: Academic Press, pages 3–24. <https://doi.org/10.1016/B978-0-12-063550-4.50007-3>
- Plutchik, Robert. 2001. The nature of emotions. *American Scientist*, 89(4):344–350. <https://doi.org/10.1511/2001.4.344>
- Poria, Soujanya, Devamanyu Hazarika, Navonil Majumder, Gautam Naik, Erik Cambria, and Rada Mihalcea. 2019. MELD: A multimodal multi-party dataset for emotion recognition in conversations. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*, pages 527–536. <https://doi.org/10.18653/v1/P19-1050>
- Posner, Jonathan, James A. Russell, and Bradley S. Peterson. 2005. The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, 17(3):715–734. <https://doi.org/10.1017/S0954579405050340>, PubMed: 16262989
- Preoțiuc-Pietro, Daniel, H. Andrew Schwartz, Gregory Park, Johannes Eichstaedt, Margaret Kern, Lyle Ungar, and Elisabeth Shulman. 2016. Modelling valence and arousal in Facebook posts. In *Proceedings of the 7th Workshop on Computational Approaches to Subjectivity, Sentiment and Social Media Analysis*, pages 9–15.
- Roseman, I. J. and C. A. Smith. 2001. Appraisal theory: Overview, assumptions, varieties, controversies. *Appraisal Processes in Emotion: Theory, Methods, Research*, pages 3–19.
- Roseman, Ira J. 1984. Cognitive determinants of emotion: A structural theory. *Review of Personality & Social Psychology*, 5:11–36.
- Roseman, Ira J. 1996. Appraisal determinants of emotions: Constructing a more accurate and comprehensive theory. *Cognition and Emotion*, 10(3):241–278. <https://doi.org/10.1080/026999396380240>
- Roseman, Ira J. 2001. A model of appraisal in the emotion system. *Appraisal Processes in Emotion: Theory, Methods, Research*, pages 68–91.
- Roseman, Ira J., Martin S. Spindel, and Paul E. Jose. 1990. Appraisals of emotion-eliciting events: Testing a theory of discrete emotions. *Journal of Personality and Social Psychology*, 59(5):899–915. <https://doi.org/10.1037/0022-3514.59.5.899>
- Rubner, Yossi, Carlo Tomasi, and Leonidas J. Guibas. 2000. The earth mover’s distance as a metric for image retrieval. *International Journal of Computer Vision*, 40(2):99–121.
- Sailunaz, Kashfia, Manmeet Dhaliwal, Jon Rokne, and Reda Alhajj. 2018. Emotion detection from text and speech: A survey. *Social Network Analysis and Mining*, 8(1):1–26. <https://doi.org/10.1007/s13278-018-0505-2>
- Sander, David, Didier Grandjean, and Klaus R. Scherer. 2005. A systems approach to appraisal mechanisms in emotion. *Neural Networks*, 18(4):317–352. <https://doi.org/10.1016/j.neunet.2005.03.001>, PubMed: 15936172
- Scarantino, Andrea. 2016. The philosophy of emotions and its impact on affective science. In *Handbook of Emotions*. Guilford Press New York, NY, chapter 4, pages 3–48.
- Scherer, Klaus R. 2005. What are emotions? And how can they be measured? *Social Science Information*, 44(4):695–729. <https://doi.org/10.1177/0539018405058216>
- Scherer, Klaus R., Tanja Bänziger, and Etienne Roesch. 2010. *A Blueprint for Affective Computing: A Sourcebook and Manual*. Oxford University Press.
- Scherer, Klaus R. and Johnny J. R. Fontaine. 2013. Driving the emotion process: The appraisal component. In J. J. R. Fontaine, Klaus R. Scherer, and C. Soriano, editors, *Series in Affective Science. Components of Emotional Meaning: A Sourcebook*. Oxford University Press, Oxford, chapter 12, pages 266–290.
- Scherer, Klaus R., A. Schorr, and T. Johnstone. 2001a. *Appraisal Considered as a Process of Multi-level Sequential Checking*, volume 92. Oxford University Press.
- Scherer, Klaus R., Angela Schorr, and Tom Johnstone. 2001b. *Appraisal Processes in Emotion: Theory, Methods, Research*. Oxford University Press.
- Scherer, Klaus R. and Harald G. Wallbott. 1997. The ISEAR questionnaire and codebook. Geneva Emotion Research Group. <https://www.unige.ch/cisa/research/materials-and-online-research/research-material/>.
- Schuff, Hendrik, Jeremy Barnes, Julian Mohme, Sebastian Padó, and Roman Klínger. 2017. Annotation, modelling and analysis of fine-grained emotions on a stance and sentiment detection corpus. In *Proceedings of the 8th Workshop on Computational Approaches to Subjectivity*,

- Sentiment and Social Media Analysis*.  
<https://doi.org/10.18653/v1/W17-5203>
- Shaikh, Mostafa Al Masum, Helmut Prendinger, and Mitsuru Ishizuka. 2009. A linguistic interpretation of the OCC emotion model for affect sensing from text. *Affective Information Processing*, pages 45–73. [https://doi.org/10.1007/978-1-84800-306-4\\_4](https://doi.org/10.1007/978-1-84800-306-4_4)
- Smith, Craig A. and Phoebe C. Ellsworth. 1985. Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, 48(4):813–838. <https://doi.org/10.1037/0022-3514.48.4.813>, PubMed: 3886875
- Srivastava, Nitish, Geoffrey E. Hinton, Alex Krizhevsky, Ilya Sutskever, and Ruslan Salakhutdinov. 2014. Dropout: A simple way to prevent neural networks from overfitting. *Journal of Machine Learning Research*, 15(1):1929–1958.
- Staller, Alexander and Paolo Petta. 2001. Introducing emotions into the computational study of social norms: A first evaluation. *Journal of Artificial Societies and Social Simulation*, 4(1):U27–U60.
- Steunebrink, Bas R., Mehdi Dastani, and John-Jules Ch. Meyer. 2009. The OCC model revisited. Online. [https://people.idsia.ch/steunebrink/Publications/KI09\\_OCC\\_revisited.pdf](https://people.idsia.ch/steunebrink/Publications/KI09_OCC_revisited.pdf).
- Stranisci, Marco Antonio, Simona Frenda, Eleonora Ceccaldi, Valerio Basile, Rossana Damiano, and Viviana Patti. 2022. APPReddit: A corpus of reddit posts annotated for appraisal. In *Proceedings of the 13th Language Resources and Evaluation Conference*.
- Strapparava, Carlo and Rada Mihalcea. 2007. SemEval-2007 Task 14: Affective text. In *Proceedings of the Fourth International Workshop on Semantic Evaluations (SemEval-2007)*, pages 70–74. <https://doi.org/10.3115/1621474.1621487>
- Strapparava, Carlo and Alessandro Valitutti. 2004. WordNet affect: An affective extension of WordNet. In *Proceedings of the Fourth International Conference on Language Resources and Evaluation (LREC'04)*.
- Toprak, Cigdem, Niklas Jakob, and Iryna Gurevych. 2010. Sentence and expression level annotation of opinions in user-generated discourse. In *Proceedings of the 48th Annual Meeting of the Association for Computational Linguistics*, pages 575–584.
- Tracy, Jessica L. and Richard W. Robins. 2006. Appraisal antecedents of shame and guilt: Support for a theoretical model. *Personality and Social Psychology Bulletin*, 32(10):1339–1351. <https://doi.org/10.1177/0146167206290212>, PubMed: 16963605
- Troiano, Enrica, Laura Oberländer, Maximilian Wegge, and Roman Klinger. 2022. x-enVENT: A corpus of event descriptions with experienter-specific emotion and appraisal annotations. In *Proceedings of the 13th Language Resources and Evaluation Conference*.
- Troiano, Enrica, Sebastian Padó, and Roman Klinger. 2019. Crowdsourcing and validating event-focused emotion corpora for German and English. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*, pages 4005–4011. <https://doi.org/10.18653/v1/P19-1391>
- Udochukwu, Orizu and Yulan He. 2015. A rule-based approach to implicit emotion detection in text. In *Natural Language Processing and Information Systems*, pages 197–203, Springer International Publishing, Cham.
- Wang, Yingqian, Skyler T. Hawk, Yulong Tang, Katja Schlegel, and Hong Zou. 2019. Characteristics of emotion recognition ability among primary school children: Relationships with peer status and friendship quality. *Child Indicators Research*, 12(4):1369–1388. <https://doi.org/10.1007/s12187-018-9590-z>
- Warriner, Amy Beth, Victor Kuperman, and Marc Brysbaert. 2013. Norms of valence, arousal, and dominance for 13,915 English lemmas. *Behavior Research Methods*, 45(4):1191–1207. <https://doi.org/10.3758/s13428-012-0314-x>, PubMed: 23404613
- Wei, Wen Li, Chung-Hsien Wu, and Jen-Chun Lin. 2011. A regression approach to affective rating of Chinese words from anew. In *International Conference on Affective Computing and Intelligent Interaction*, pages 121–131.
- Wierzbicka, Anna. 1994. Emotion, language, and cultural scripts. *Emotion and Culture: Empirical Studies of Mutual Influence*, pages 133–196. <https://doi.org/10.1037/10152-004>
- Wilson, Theresa. 2008. Annotating subjective content in meetings. In *Proceedings of the Sixth International Conference on Language Resources and Evaluation (LREC'08)*.
- Wolf, Thomas, Lysandre Debut, Victor Sanh, Julien Chaumond, Clement Delangue,

- Anthony Moi, Pierric Cistac, Tim Rault, Remi Louf, Morgan Funtowicz, Joe Davison, Sam Shleifer, Patrick von Platen, Clara Ma, Yacine Jernite, Julien Plu, Canwen Xu, Teven Le Scao, Sylvain Gugger, Mariama Drame, Quentin Lhoest, and Alexander Rush. 2020. Transformers: State-of-the-art natural language processing. In *Proceedings of the 2020 Conference on Empirical Methods in Natural Language Processing: System Demonstrations*, pages 38–45. <https://doi.org/10.18653/v1/2020.emnlp-demos.6>
- Wu, Chuhan, Fangzhao Wu, Sixing Wu, Zhigang Yuan, Junxin Liu, and Yongfeng Huang. 2019. Semi-supervised dimensional sentiment analysis with variational autoencoder. *Knowledge-Based Systems*, 165:30–39.
- Xia, Rui and Zixiang Ding. 2019. Emotion-cause pair extraction: A new task to emotion analysis in texts. In *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*, pages 1003–1012. <https://doi.org/10.18653/v1/P19-1096>
- Yanchus, Nancy Jane. 2006. *Development and Validation of a Self-report Cognitive Appraisal Scale*. Ph.D. thesis, University of Georgia.
- Yih, Jennifer, Leslie D. Kirby, and Craig A. Smith. 2020. Profiles of appraisal, motivation, and coping for positive emotions. *Cognition and Emotion*, 34(3):481–497. <https://doi.org/10.1080/02699931.2019.1646212>, PubMed: 32314674
- Yih, Jennifer, Andero Uusberg, Weiqiang Qian, and James J. Gross. 2020. Author reply: An appraisal perspective on neutral affective states. *Emotion Review*, 12(1):41–43. <https://doi.org/10.1177/1754073919868295>
- Yu, Liang Chih, Lung-Hao Lee, Shuai Hao, Jin Wang, Yunchao He, Jun Hu, K. Robert Lai, and Xuejie Zhang. 2016. Building Chinese affective resources in valence-arousal dimensions. In *Proceedings of the 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, pages 540–545. <https://doi.org/10.18653/v1/N16-1066>
- Zhang, Lei and Bing Liu. 2011a. Extracting resource terms for sentiment analysis. In *Proceedings of 5th International Joint Conference on Natural Language Processing*, pages 1171–1179.
- Zhang, Lei and Bing Liu. 2011b. Identifying noun product features that imply opinions. In *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies*, pages 575–580.
- Zhuang, Liu, Lin Wayne, Shi Ya, and Zhao Jun. 2021. A robustly optimized BERT pre-training approach with post-training. In *Proceedings of the 20th Chinese National Conference on Computational Linguistics*, pages 1218–1227.