

The mental ingredients of bitterness

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Abstract In view of multimodal interfaces capable of a detailed representation of the User’s possible emotions, the paper analyses bitterness in terms of its mental ingredients, the beliefs and goals represented in the mind of a person when feeling an emotion. Bitterness is a negative emotion in between anger and sadness: like anger, it is caused by a sense of *injustice*, but also entails a sense of *impotence* which makes it similar to sadness. Often caused by betrayal, it comes from the *disappointment* of an *expectation* from oneself or another with whom one is *affectively involved*, or from a *disproportion* between *commitment* and actual results. The ingredients found in a pilot study were tested through qualitative analysis of a further questionnaire, which confirmed the ingredients hypothesized, further revealing the different nature of bitterness across ages and across types of work.

Keywords Bitterness · Social emotion · Cognitive model of emotion

1 Multimodal Interfaces and the analysis of emotions

A relevant area in research on Multimodal Interfaces is the construction of Empathic Agents [13]. In principle, an empathic agent should emulate an empathic human as close as possible, but so far it may not yet be so. In a human, we must

distinguish between feeling empathy and expressing empathy (a nurse may feel deep empathy toward a patient and yet not display it, not to let him worry more; if someone I hate had an unlucky accident I may hypocritically show sorry to him). Agents are not as yet able to feel empathy for the User, while they can express it. Yet, it is not the same to show empathy in case of positive vs. negative emotions, nor, within the same valence, for joy vs. pride, or sadness vs. anger. So, whether or not an Empathic Agent can feel emotions, to be empathic it must be endowed with an internal representation of the other’s emotion.

In the last decades research on emotion has gone far away. Several domains have been widely and deeply explored, functions of emotions, neuro-physiological mechanisms, verbal and multimodal communication, effects on everyday life, allowing advances in Affective Computing and emotion simulation. Nonetheless, more in depth investigation is needed at least in two aspects of emotion research.

On the one hand, the range of emotions studied is still narrow. Maybe because investigation often moved from the standpoint of emotion expression, a great number of studies have been devoted to the so called, famous, primary emotions: presumably innate, universal, displayed by the same expressive pattern in all cultures, and of early emergence. But the primary ones are only a bunch of emotions in the infinite number of affects we happen to feel in our everyday life. It is (unfortunately) very rare that we feel happiness, and not so frequent, also, that we feel disgust. Even fear (fortunately) is not an emotion we feel everyday, except, perhaps, in countries confronting a war. Nonetheless, our everyday life is full of emotions, that, albeit different from the primary ones, actually colour our mood and make us feel merry or upset. At work, for example, emotions heavily affect our relationship with colleagues, bosses, and customers: we often feel envy or indignation, anxiety or humili-

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ation, contempt, admiration, sense of injustice or bitterness. So the time has come to focus also on these “Cinderella” emotions: ones that do not always give rise to a canonical bodily expression, and yet are very important in determining our quality of life.

Another problem in present emotion Affective Computing research is the lack of a deep and thorough conceptual analysis of the emotions under focus: a search for the specific beliefs implied in different emotions, that characterize and distinguish each single affective state from all others. Such an in-depth analysis would be useful for Multimodal Interfaces and Empathic Agents: a detailed representation of the beliefs implied by a certain emotion might be taken into account by the Interface to update its User Model and tailor its empathic expression by focusing on certain aspects of the User’s feeling more than on others. Suppose the Empathic Agent is a friend that helps you regulate your emotions: it should display very different behaviours if you were feeling, for example, bitterness instead of anger, where feelings, beliefs and action tendencies are very different. Only a representation that distinguishes the two emotions might result in more appropriate empathic reactions.

To confront these issues, this paper studies bitterness, an emotion that people happen to feel with fair frequency, and that may have a relevant impact on their daily life. We propose an analysis of bitterness in terms of its mental ingredients, the beliefs and goals that are supposedly represented in the mind of a person when s/he is feeling an emotion. Our analysis is tested through two empirical studies that investigate people’s definitions of bitterness and descriptions of their feelings and experiences in this emotion.

2 Bitterness

Bitterness has not been subject to specific analytical study in the psychological domain. An isolated exception is feminist literature where, within the exploration of anger, bitterness is defined as “a refusal to forgive and forget”, a tendency “to maintain a vivid sense of the wrongs one has been done, to recite one’s angry litany of loss long past the time others may care to listen or sympathize” [10]; but also, “a rational response to the frustration of important and legitimate hopes” [3]. Starting from these definitions, Campbell observes that bitterness differs from anger for its failure of uptake, since the one who is recounting his injury here fails to be listened to. While people devote attention to one expressing anger, when someone accuses you to be “bitter” he is silencing you, as if annoyed of listening to your complaint, and thus dismisses you, that is, he subtracts any importance to your being and saying. Yet, this analysis of bitterness is only sketched, since Campbell’s paper mainly focuses on the political sense of being accused of being “bitter”.

A close feeling is grudge [14]: a kind of silent hate that lives on through rumination of the wrong received, and sometimes made. But while grudge is a “social emotion”, since it is definitely directed to another, bitterness is a sort of sad anger, that is hopelessly retorted to oneself.

To provide a more analytical definition of bitterness we need to find out its “mental ingredients”.

3 Mental ingredients: an approach to the analysis of emotions

The view of emotions we adopt for our analysis is a cognitive model in terms of goals and beliefs [6]. As in other models [7, 15] an emotion is seen as an adaptive device that monitors the state of achievement or thwarting of a person’s important goals: a complex subjective state encompassing cognitive, physiological, expressive, motivational aspects, which is triggered as one believes that a current event causes or is likely to cause the achievement or thwarting of one’s adaptively important goals [4, 5]. The cognitive side of an emotion includes the “mental ingredients” that, according to this view, must be represented in the mind of a person who is feeling that emotion: beliefs, expectations, evaluations, causal attributions, referred to an assumed or imagined event that is relevant for one of the person’s important goals, but also the goal that is monitored by that emotion, and the goals triggered by it [9, 11, 12].

To discover the mental ingredients of an emotion one must go through real or fictitious cases, collected either through the researcher’s introspective analysis or through empirical research, in which that emotion actually has been or in principle can be felt. The features shared by all positive examples are the ingredients of that emotion. Yet, one should distinguish the minimal necessary set of ingredients from those that may add in some examples but not in others: when you think of cases in which you might feel or actually have felt an emotion, some are prototypical cases of it, while others are not, and yet they can still be examples of that emotion. For instance, looking for the conditions to feel guilty, one that immediately comes to mind is *responsibility*, which pops up in the most typical cases of guilt feelings, e.g. if you run over someone because you’re drunk. But in some cases there is no responsibility, and yet guilt may be felt: take the survivors of concentration camps who feel guilty even if they had no responsibility for the others’ death. The real crucial condition for feeling guilty is the sense of *inequity* of an event, whether or not due to our responsibility [4]. In brief, some ingredients of an emotion, some apparently crucial conditions of it in fact don’t hold in all instances of that emotion, but only in its prototypical cases, while others are so necessary that without them the emotion cannot be felt: these constitute the “core” ingredients of that emotion,

and are common to both prototypical and more peripheral cases, while others only hold for the most central examples. Thus we must not constrain research to prototypical cases of the emotion, but take all positive cases into account, to find all the ingredients and distinguish the “core” ones that are present also in non-prototypical cases.

4 The ingredients of bitterness. A pilot study

To find out the mental ingredients of bitterness, we first designed a pilot study to define this emotion on the basis of real examples. 40 subjects were submitted a questionnaire of 18 open, yes-no and multiple choice questions concerning the following topics:

1. Definition: questions asking to narrate a case of bitterness, tell the cause of this emotion, and describe its specific feeling
2. Mental states: questions paraphrasing the ingredients hypothesized to test how much they are present in the subjects' feeling of bitterness
3. Fields of occurrence: a question asking if bitterness is experienced more often in work, school, politics, sport, entertainment, family, love or friendship
4. Relation to other emotions: one question about how far bitterness is from disgust, disappointment, resignation, grudge, contempt, sense of injustice, anger, sadness, resentment, regret, indignation, impotence and revenge
5. Ways, effects and functions of the communication of bitterness: questions asking if and how the subject communicates it; how can s/he understand it from others' behaviour, and what are the effects of communicating it or not on future relationships
6. Impersonating bitterness: one question asked subjects to impersonate bitterness: “Imagine you are on the stage and you have the feeling of bitterness talk: you impersonate it. What do you think it would say? How could it describe itself?”.

From the participants' answers we singled out a list of mental ingredients, some always and necessarily present, others present only in some prototypical cases. Let us first highlight the ingredients in a prototypical example: feeling betrayed by someone you trusted.

I believe that trust is a very important value in *friendship*; once I came to know that a friend of mine had concealed something to me, not telling me the truth: *she had betrayed* that absolute *value of trust*, and *I did not expect* it in any way. I felt bitterness and, in fact, *disappointment*, out of a behaviour *I thought could never occur*.

This example is prototypical in that it contains many crucial ingredients of bitterness: A person *A expects* some behaviour *X from another person B*, with whom *A is affectively involved*. A believes *B is committed* to do *X*. But *B*

disconfirms A's expectation, and this causes that a *goal* of *A* is *thwarted*.

Sometimes, though, also a feeling of *injustice* adds to those ingredients:

(I felt bitterness) at school when I got a bad grade in physics after I had studied it very much and it was my birthday.

Even more specifically, in some cases what causes bitterness is the peculiar harm and injustice of *being humiliated*

It is an emotion caused by a situation in which a person addresses another with arrogance, presumption, almost as in a power abuse.

In any case, A feels that harm (the goal thwarting) is *irreversible*:

Then, with time passing, (relations) improved, but they have never been again as before.

To sum up, the ingredients of bitterness in its prototypical cases are the following:

1. goal	A has a goal G
2. responsibility	A believes B is responsible for the fulfilment of G
3. commitment	A believes B is committed to G's fulfilment
4. expectation	A expects B will cause/allow the fulfilment of G
5. involvement	A is involved (wants to have positive relations) with B
6. disappointment	A's expectation is disconfirmed
7. goal thwarting	A's goal G is thwarted
8. irreversible	In an irreversible way
9. injustice	This is unjust for B

A feels bitterness when his goal *G* is thwarted in an irreversible way causing injustice to *A*, and when *A* believes that the responsible for this thwarting is another person *B*, with whom *A* is affectively involved, whom *A* expected would allow or cause the fulfilment of *G*, who *A* believes was committed to fulfil it, and who disconfirmed *A's* expectation.

Yet, in some examples of our pilot study not all of these ingredients are present:

The case in which I felt bitterness was during the oral examination at Grammar School, because it did not go the way I would have liked, and I immediately felt bitterness since in my opinion I could have done more, but it was late.

In this case, the person *A* believes was committed to fulfil *G* is *A* herself, and the ingredient of *injustice* does not seem to be present. At most, *A* feels she *betrayed* herself:

she somehow feels guilty toward herself, *responsible* for an *irreversible harm* she inflicted to herself.

Thus, a common ingredient of bitterness, either caused by others or by oneself, is *responsibility* for a *non-achieved goal*. As put by a subject.

Bitterness is an emotion you feel when you had the possibility to do something to achieve a goal, but this was not done and as a consequence the goal has not been achieved.

The sense of bitterness due to *disconfirmed expectation* and *inequity* may be also caused by the disproportion between personal investment and actual results.

After years of study, fatigue and *striving* I still can't find my own realization in the work domain.

In other cases, the salient ingredient is only *injustice*, due to *non-motivated harm*.

I, for example, felt bitterness when something happened that caused pain to someone *without an acceptable motivation* and no one could contribute to soften such pain. When the father of a friend of mine died, I used to feel a deep bitterness while thinking of her suffering, but I did not know how to soften her pain.

Actually, some of the ingredients of bitterness, *goal thwarting*, *expectation*, *involvement*, *the other's responsibility*, and *injustice*, are typical ingredients of anger. But *goal thwarting* following an *expectation* is the core of disappointment [11], while another aspect likens bitterness to sadness: a feeling of *impotence to react*, to recover the damage undergone, because those who caused the injustice are stronger than we are.

In fact, you typically feel bitterness when you struggle with very powerful agencies, like, say, mafia, or a judiciary system that is unjust and iniquitous: you feel them too more strong and powerful than you, and conclude you have no chance to win over them. Your sense of injustice is high, but you feel you cannot do anything to overcome it; if, as [3] puts it, “an expression of bitterness begins its life at some point as intended anger”, you start feeling that your cry of anger has no point, no weapons to win, and anger becomes restrained anger, since it cannot find anyone to listen.

Beside impotence to react, bitterness also entails the very impotence to express one's disappointment. It is a kind of restrained disappointment that lasts in time, just because restrained. As goes a subject's definition,

Bitterness is a sensation you can feel after a great disappointment. Disappointment can leave you this sense of void, of bitterness, that can last in time.

What is the process that leads to bitterness? When a person believes she is subject to injustice, anger may be felt. But if she also feels impotence to react, because the one who

caused the injustice is too strong that one cannot oppose it, this triggers sadness. This mix of sadness and anger that action cannot rescue, and that cannot be expressed, gives rise to a long-lasting disappointment and sadness, which results in bitterness.

Moreover, if the injustice that caused bitterness is brought about by another person, or simply you believe another is the cause of your bitterness, then you also start to feel grunge toward the other, with grudge being a restrained anger toward someone that one cannot act out [14]. Thus, bitterness might be considered the individual—non social—side of grudge.

5 A quanti-qualitative analysis of bitterness

The pilot study above resulted in a set of ingredients that we hypothesize define the emotion of bitterness. By taking them as a working hypothesis, in a subsequent study 110 subjects (35 males (32%) and 75 (68%) females), between 14 and 78 years old (32.9 m) were submitted another questionnaire, slightly modified with respect to the former, of 18 open, yes-no and multiple choice questions. A quanti-qualitative analysis of the answers will be overviewed in a subsequent work; here we test the psychological validity of the ingredients found in the pilot study by focusing on the questions concerning the definition of the emotion, its fields of occurrence, its relation to other emotions, its communication, and the question on impersonating bitterness.

We obtained a *corpus* which counts 14058 (*V*) occurrences with 2811 (*N*) different words and a medium lexical richness index $[(V/N) \cdot 100]$, equal to 19,99%.

An automatic quanti-qualitative analysis was performed on the subjects' answers by *TalTac* (*Trattamento Automatico Lessicale e Testuale per l'Analisi del Contenuto*, i.e. “Lexical and Textual Automatic Processing for Content Analysis”: [2]), a software for textual data analysis based on a “lexicometric approach”: an application of statistical principles to textual corpora. The “textual statistics” [8] aims to extract the semantic level in a text starting from the list of words obtained by statistical analysis; for example, in the specificities' analysis, the software extracts a list of significant words obtained by a statistical comparison between sub-parts of text according to selected variables.

5.1 Textual and lexical analysis

The lexical analysis includes some descriptive information, particularly interesting for the understanding of bitterness, like *theme words* which represent the most frequent words out of all occurrences, *adjective analysis* and *time analysis*.

Theme words. Theme words show the main topics considered in the answers of the questionnaire: the definition

through similar emotions like *disappointment* (77 occurrences), *resentment* (15), *sadness* (37); the main modality of expression (*silences*, *silence*, respectively 29 and 18 occ.) and some ingredients of bitterness like *expectation* (15 occ.) and *trust* (14).

Adjective analysis. We used the dictionary of positive and negative adjectives present in TalTac2 by analysing the negative index¹ to identify polarization through positive or negative lexicon. The index reveals that the characteristics of negative polarity of words in the corpus is as high as 76%, that is higher than the reference value (40% according to a research based on Italian corpora; [1]). The adjectives are focused on the negative emotional experience surrounding bitterness: among the most frequent, *wounded*, *powerless*, *sad*, *empty*.

Time analysis. Time analysis reveals an *orientation to the past*, because out of all verb frequencies our subjects express time information most frequently as past tense (68%, as opposed to 29% present and 3% future), but out of the three categories of age, “up to 25”, “from 26 to 40”, and “from 41 on”, this percentage increases up to 70% for the third one. So in defining bitterness they tend to describe the time of the emotion as time *told* rather than time *lived*, possibly to put distance between themselves and their feeling, and to have a more complex interpretation of facts. Such an interpretation is also supported by the frequent use of *reflective verbs* like *considered*, *believed*, *expected*, *thought*; this is also coherent with the idea of bitterness as an emotion of memory, of a negative past, and as a way to ruminate over one’s wrongs [3], as well as with the ingredient of *failed expectation* seen above.

- *I expected* more collaboration from my collaborators, colleagues and workers ...
- When a person at work that *I believed* trustworthy in many ways tried to stop me
- For instance when a person *I considered* a friend concealed me important things

5.2 The peculiar lexicon of bitterness

Beyond the absolute value of words, the *key words* or *peculiar lexicon* [2] are the words that result over-represented in the text under analysis by comparing the corpus to an external frequency lexicon, taken as a reference model.² The measure of the variance from the reference lexicon is represented by the *standard deviation*, which is the deviation between the form frequencies in the analyzed text and in the frequency lexicon [2].

¹The index is obtained by calculating the ratio between the total of negative occurrences and the total of positive ones (tot. Occ. Neg/tot. Occ. Pos/100).

²In this case we used the *standard Italian*, resource in Taltac.

Table 1 Personal investment

s.d	Graphical form	s.d	Graphical form
Relational trust		14.45	Boyfriend
33.37	Reliable	13.17	Engaged
33.37	Trusted	5.77	Girlfriend
26.59	Trust	13.17	Engaged
23.92	Confident	11.25	Engagement
20.89	to trust	Commitment	
20.89	Being confident	33.37	Commit myself
Affection		27.15	Profuse
65.63	Friend	12.11	Ttraining
43.02	Friendship	4.32	Engagement
36.18	Feelings	Giving verbs	
19.05	Friends	19.01	Giving him
13.17	Friendly	11.66	Gave

From the corpus of answers we extracted some semantic areas that are quite close to the ingredients of bitterness previously hypothesized. First, a very large area of PERSONAL INVESTMENT (Table 1) is mainly represented in terms of relational trust (*to trust*, *trust*, *reliable*, *confidential*, *confident*), AFFECTION (*friend*, *friends*, *friendship*, *affection*, *emotion*, *girlfriend*, *boyfriend*, *care*), COMMITMENT (*to commit myself*, *engagement*, *training*), and corresponds to verbs of giving (*giving*, *gave*, *offered*).

The second semantic area refers to a central aspect of bitterness: FAILED EXPECTATIONS. Subjects often use the past tense of estimation verbs like *expect*, *believe*, *think*, attributing the cause of bitterness to past and to beliefs of betrayal. Further, some terms recurrently refer to a SENSE OF INJUSTICE and to BAD FAITH or DECEPTION, a tendency to attribute a heavier responsibility to the “betrayed” (Table 2). Bitterness is then an emotion caused by rumination about an enduring injustice; in this line the feminist approach [3] admits that it does not involve only gender but in general disadvantaged groups, including, as to persons the divorced, disabled, ill, and as to groups, the working class. She points out the positive role of bitterness as “refusal to forgive and to forget (...) to maintain a sense of the wrongs one has been done” [10, 146], as a way to store the condensed injustices; in this sense is bitterness an emotion of memory.

While talking of bitterness, participants frequently imply a semantic core of impotence, powerlessness, to be interpreted in two senses. One is impotence of doing something to overcome injustice or to change a situation, due to one’s low level of control over circumstances.

- To feel bitterness means that you cannot *change* things when you really would like they were different
- A feeling that expresses the impossibility of achieving the goal one imagines to achieve
- The impossibility of modifying the situations one is living

Table 2 Failed expectation

s.d	Graphical form	s.d	Graphical form
Cognitive expectation		8.67	I knew
82.00	You expected	7.66	We expert
70.94	You believed		Sense of injustice
65.95	Expectations	49.90	Unjustly
35.78	I believed	34.96	Injustice
29.19	I expected	12.61	Unjust
28.13	Expected		Bad faith/reception
27.15	They were foreseeing	56.77	Betrayed (fem.)
26.34	Certainties	47.19	Betrayed (pl.)
25.93	Right	35.58	Betrayal
23.63	Esteem	33.37	Naughty things
23.44	Broken	20.89	Artificially
20.89	You thought	15.36	Deceptions
19.01	Disappointed	11.66	Betrays
10.22	Expectation	8.15	Deception
9.15	Failed	7.66	Trap

The second sense of impotence is the difficulty of expressing bitterness. Often subjects confirm they didn't express bitterness to the person who had caused it, although they express it to other people.

- Now I know that to feel better I should have *expressed* my bitterness, and I understand it from my own attitude, from how nervous I feel
- I wouldn't have managed to *express* my affective state, it is difficult to manifest one's feelings to someone who showed not very sensitive
- It is not a feeling I can *express* or describe easily; it is a feeling of anger and regret that I feel mainly toward myself

The lexical analysis of Table 3 shows words like *silence*, *silent*, *depression*, *apathy*, *closeness*, *close myself*, others mentioning non-verbal communication like *gazes*, *face*, and finally verbs of dissimulation like *mask*, *conceal*, *hide*, *forget*. Finally a deep uneasiness is represented by a nervous mood expressed by words like *irritation*, *snorting*, *imprecating*.

5.3 The characteristic lexicon of bitterness

The analysis of specificities aims to identify the *characteristic lexicon* by comparing different sub-parts of text. The characteristic lexicon is created by dividing a corpus into sub-texts (so called *sub-occurrences*) according to the different levels of a chosen variable (e.g., to characterize a lexicon by gender, you divide the corpus into male and female sub-texts). Then the different sub-texts are compared, by a *t-test*

analysis, to extract a list of words over-represented or under-represented with respect to a normal distribution³ [2, 8].

In the present study, we chose two main variables, *age* (up to 25 years old; from 26 to 40; from 41 on) and *type of work* (worker, housewife, student, self-employed). In the young subjects we find a sort of “light bitterness” oriented toward something external (*towards, towards someone*; $p < 0.01$), mainly injustice about University or in a competition (*score, injustice*; $p < 0.01$). The frequent graphic form *who* might be an impersonal way to define bitterness by mentioning a case in which the subject is not involved.

Here are some of the participants' accounts.

- When there are people who waste thousands of euros for a car and others that really can't afford one this is *injustice*
- When a *friend* of mine had a better grade and he had studied less than I had
- When I quarrelled with a *friend* of mine, long time ago, during a game between friends

Furthermore, the youth consider it possible to express the negative emotion (*express, felt*) and to improve the damaged relation (as in the case of *improved* below):

- Slightly better, because I got rid of what I was feeling inside. The relationships *improved*
- It was a way to give vent to it: I expressed it by trying to have a dialogue and understand why

With subjects from 26 to 40, two ingredients starts to appear. One is the sense of IMPOTENCE, emerging for example in conditionals like *would be* ($p > 0.01$); the other is POINTLESS COMMITMENT and striving, mainly at work. Bitterness in organizational contexts make the quality of life at work go worse.

- Because it *would have been* self-defeating
- Because it *would have been* pointless
- Too difficult to find the words, and I thought it *would have not be* useful, may be worse
- Notwithstanding *commitment* and devotion there was no acknowledgement of the quality and value of my work
- After so much of a *striving*, I saw my job stolen by an incompetent girl with no experience, but “intimate”

Useless commitment can also be seen in subjects who, again at work, committed their esteem to someone who did not deserve it

- I felt bitterness as I realized I had trusted and *esteemed* a person who did not deserve it. I was disappointed by the betrayal of my trust

³The characteristic element index is calculated for all the units with a frequency of more than 5, with a probability threshold set at 5% through T-test [2, 145].

Table 3 Impotence

s.d	Graphical form	s.d	Graphical form	s.d	Graphical form
Impotence		47.19	To give vent	13.17	Melancholic
52.10	Impotence	42.45	Nervousness	12.48	Ridde
38.02	Impotent	36.47	Physically	12.11	Silent
23.44	To be able (for myself)	33.37	Close myself	11.66	Annoyance
9.70	Impossibility	33.37	Puffing	5.86	Pessimism
9.39	To be able (for it)	33.37	imprecations		Dissimulation
Difficult to express		31.20	Grimaces	22.15	Impersonate
520.53	Silences	27.99	closure	16.69	Dissimulate
289.52	Gazes	27.15	Silent	13.83	Mask
191.70	Espress it	27.15	Depressed	9.49	Conceal
100.54	Facial	27.15	Apathy	7.25	Remove
87.92	Expression	27.15	Masse	5.89	Disappear
55.65	Silence	26.61	Cold	5.66	Forget
51.59	Mood	19.01	Shy	4.71	Hide
50.26	Face	16.75	Cry		

Table 4 Light bitterness (up to 25 years old)

Grafic form	tot occ.	sub occ.	<i>p</i> -value
Score	5	5	0.01
Feelings	11	8	0.01
Felt	28	16	0.01
So that	6	5	0.02
Bettered	6	5	0.02
Injustice	6	5	0.02
Who	14	9	0.02
I was feeling	8	6	0.03
Express	8	6	0.03
Toward	28	15	0.03
Friend	13	8	0.05
Towards	13	8	0.05

Table 5 Deep bitterness (from 41 years old)

Grafic form	tot occ.	sub occ.	<i>p</i> -value
Memory	6	5	0.01
Pain	26	13	0.01
Deep	11	7	0.01
Sadness	48	20	0.02
I thought	7	5	0.02
Empty	16	8	0.04
Strong	6	4	0.05
Wound	6	4	0.05
Death	6	4	0.05
Silence	23	5	0.02

Subjects from 41 on acknowledge a “deep bitterness” using words of high intensity (*pain, deep, feeling of emptiness, wound*); they report an inner bitterness closed in themselves: they strongly remember (*memory*, $p < 0.01$) but refrain from expression (*silence*, $p < 0.01$).

Finally, different types of work entail different ways to live bitterness. Factory workers, housewives and shop assistants tend to explain it in from a *subjective* point of view, as a way to understand and to find a sense of this emotion, lived with high intensity; they define it in terms of *memory, emptiness, reason, pain, soul, empty out, lived* ($p < 0.05$), just like in Campbell’s [3] definition of bitterness for the disadvantage group.

To the contrary, bitterness is described by autonomous workers, doctors and students in a more *relational* way: they adopt external attribution, identifying causes and re-

sponsibilities or other contextual aspects (*expectations, job, waited, detached, improved, vote, towards, who*; $p < 0.05$).

6 General discussion

The manual and automatic qualitative analyses performed in the two studies provide a coherent picture of the mental ingredients and processes of bitterness. The ingredients found in the pilot study were confirmed and enriched through by the automatic analysis. Take the focus on temporality, which points to the importance of rumination for the very definition of bitterness. As an expectation is disconfirmed you may feel disappointment, but only thanks to rumination can bitterness be felt: re-living your past experience contributes to make you feel how irreversible the goal thwarting is. The relevance of time may also account for why bitterness is more deeply felt by older than younger people: older people

have had more time to ruminate, but also to discover how irreversible the damage was. And irreversibility is even more severe if you have, not only more time in your past, but less time in your future, to recover from irreversible damage. So while in a young person bitterness may be overcome by optimism and hope in the future, and the wrong cured, in an old one there is no more time and the wrong remains pending.

7 Conclusion

A clear and detailed representation of emotions may help to construct Multimodal Interfaces capable of sophisticated interaction and empathic communication.

Bitterness is an emotion that may have a relevant impact on people's quality of life in everyday affective relations and in work. This paper aimed to find the mental ingredients of bitterness, the beliefs and goals represented in the mind of a person who is feeling it.

Bitterness is a negative emotion caused by a somehow *irreversible thwarting of a goal*. Something in between anger and sadness, like anger it is often due to a sense of *injustice*, sometimes also caused with full *responsibility*; but it entails a sense of *impotence*—impotence both to react to injustice and to cry out one's anger—which makes it similar to sadness. Its feeling is due to the *disappointment* of an *expectation* about the behaviour of oneself, of another person one is *affectively involved* with, or of some agency one believes should guard justice. The disappointed expectation may take the form of a sense of *betrayal*, but sometimes simply comes from a *disproportion* between *lavished effort or commitment* and actual outcomes, and, when processed through *rumination*, results in bitterness.

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