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## **THE MEANINGS OF THE SIGH VOCAL EXPRESSION ALONG THE ROUTE OF OUR DESIRES**

### **1. Introduction**

During face-to-face and media audio-visual communicative interaction, our vocal behavior is not only made of words, but of a various types of vocalizations, both communicative and non-communicative, deliberate and spontaneous, aware and unaware. A laughter for example may involuntarily express or deliberately communicate some emotion – amusement, gloating, happiness (Ruch, Ekman 2001; Owren, Bachorowski 2003; Mancini et al. 2017) – or convey derision; crying displays a feeling of impotence linked to negative or even positive emotions (Miceli, Castelfranchi 2003), which may in turn imply a request for help. If I pant after a speed run, the loud voiced inspiration may simply be a side issue of my increased need for air, and in the same vein, if I snort while climbing stairs, the need for a conspicuous, then acoustically loud expiration may simply convey physiological states like effort or fatigue. Yet, I might snort loudly also with a communicative intent, to convey I am ‘fed up’, mentally tired or even annoyed with something. Again, a real cough may be simply a symptom of bronchitis, but a flaunted one may communicate an allusive warning – for instance to someone speaking badly of a third person who is just entering the room.

A kind of vocalization people sometimes deliver either in solitude or during interaction is the sigh: a particular type of deep breath that can have either expressive or communicative functions: it can be used by a person both when alone and in presence of, possibly addressed to other people, with or without a deliberate communicative goal.

This work reports three studies proposing a semantic analysis of the sigh, and tries to account for its multiple meanings in

terms of a socio-cognitive view of mind, social interaction, and communication.

Sect. 2 presents related work on sighs, Sect. 3 overviews some theoretical notions of our model, to be exploited in the subsequent analysis; 4 proposes a definition of sigh, 5, 6 present two qualitative studies and 7 a perception study on a particular use of sighs in political debates. Sections 8 and 9 frame the sigh within a general view of human goal pursuit, showing how it punctuates all its phases.

## 2. Previous works on sigh

The phenomenon of sighing has been studied on two sides, with respect to its triggers and its physiological mechanisms, and with regard to its functions as a semantic and interactional signal.

From the physiological point of view, a sigh is a deep augmented breath, a second act of breath starting when another is not yet over (Boncinelli 2016; Li et al. 2016), that due to actual need for more air or to emotional events gives rise to a second inspiration. It differs from the common eupneic breath since it starts as normal breaths but is followed by a long pause in respiration named 'postsigh apnea' (Ramirez 2014).

Sighs have an important ventilatory role to maintain normal lung functioning. It has been shown that they are crucial for survival; for instance, in genetically engineered mice which could not sigh it was observed that they eventually died due to critical lung problems. But sighs are not related only to our respiratory functions, they also have an important role in understanding and communicating our emotional health (Ramirez 2014).

During conversation they may as well be treated as fairly relevant for interaction, since they can be socially meaningful, due to their capacity of expressing emotions. Since the sigh is manipulable, it can be used consciously and for social ends: in fact, depending on where and how a sigh begins it may influence how listeners perceive its meaning in interaction (Hoey 2014). Hoey conducted a study on 54 sigh tokens identified in video and audio recordings of natural interactions in American English, distinguishing them on the basis of their position in the conversation:

- *Pre-beginning sighs* can both project and preview upcoming talk; they forecast the valence of upcoming talk by exploiting the negative affective association of sighs.

- *Post completion sighs* are stance markers, placed for example after the recognizable completion of a turn or to bring the talk to a conclusion, providing a space to show reactions to the ended talk (laugh, smile, etc)
- *Standalone sighs*: their recurrent function is to receive information or acknowledge some recently-changed state.
- *Transitional sighs* have a role in situations like incipient talk, for example they can be used as 'outlouds', which may serve as the grounds for getting back into turn-by-turn talk.

In the psychological domain, Teigen (2008) reports three studies on sighs: in the first one, through a questionnaire submitted to 75 students in psychology he highlighted that sighs are mainly associated with negative, passive, and low-intensity emotional states; another study conducted on 117 medical students investigated the interpretation of sighs in various scenarios, suggesting that those produced by others are attributed meanings like sadness, while self-produced ones most likely convey giving up or surrendering. In the last study 36 participants were asked to solve impossible puzzles, causing a high number of futile attempts, which in turn lead to a plethora of sighs. Teigen infers that sighs are mostly unintentional expressions of some course of action, a wish, or a plan that has been stricken out, and their function is to provide a long pause before a new plan is produced, replacing it with a new initiative. Based on these studies, Teigen (2008) lists eleven categories of sighs:

- (1) Sadness (including sorrow, depression, disappointment, and loneliness)
- (2) Giving up (resigned, helpless, despondent)
- (3) Weariness (tired, exhausted)
- (4) Boredom (unmotivated, restless)
- (5) Frustration (stress, irritated, displeased)
- (6) Other negative emotions (jealous, afraid, nervous, envious, hungry)
- (7) Happiness (joy, in high spirits, in love)
- (8) Satisfaction (relieved, well-being, content)
- (9) Relaxed (silent, tranquil)
- (10) Empathy (sympathetic, compassionate)
- (11) Other (surprised, excited, 'strong feelings')

### 3. Internal states, communication and expression

Many vocal signals – from a baby’s cry to an interjection like *ooh!*, from a laughter to a sigh, may have either an expressive or a communicative function. To distinguish these cases, before focusing on the semantic analysis of the sigh, we first overview some theoretical notions we will use in its definition and analysis, drawn from our model of communication in terms of goals and beliefs (Poggi 2007).

We can define as communication any case in which a natural or artificial system A (Sender) has the goal of having another natural or artificial system B (Addressee) acquire some belief C; and when A, in order to this goal, displays a signal *s* that (A believes) is linked, in both one’s own and B’s mind, to belief C, which is, therefore, the Meaning *M* of signal *s*. The signal is a physical stimulus – a morphological trait, an action or even a non-action (silence, for instance) – that can be perceived by B’s sensory devices in one or more possible modalities (vision, audition, olfaction, taste, touch). The meaning is a belief concerning the surrounding world, A’s own identity, or A’s own mental states presently active in A’s mind.

A’s goal of communicating, a necessary condition of our definition of communication, is not necessarily a deliberate and conscious goal – this would rule out all animals’ but also part of humans’ signalling as not strictly speaking communicative – since we may count various sources of communicative goals and various levels of consciousness.

Communicating belief C to B may be an internal goal, that is, one represented in A’s mind, but even in this case it may be a conscious, an unconscious, or a tacit goal. A conscious goal is not only represented, but meta-represented in A’s mind, as is the case with verbal communication: I do not only want to communicate C, but I also want you to know that I want to make you know C (Grice’s, 1957, necessary condition for communication). Yet, in some cases I may also communicate my own embarrassment while not even being aware that I want to: in this case my goal of communicating is represented but not meta-represented, due to dynamic reasons. Finally, when I stress a syllable or raise my eyebrows to underline and emphasize some concept, I do have the goal to stress its importance, but I am not consciously doing so.

Again according to Poggi (2007), besides the goals that are represented (and possibly even meta-represented) in the system’s

mind, other communicative signals are governed by goals that are not represented in the system, but nonetheless impinge on it, namely biological functions and social ends. For instance, the seagull mother's spot on her beak is a morphological trait determined by the biological function of indicating the chick where to peck; our regional accent is determined by the social end of reminding others and ourselves of our cultural roots, even in cases when we would not like to manifest them.

Based on these notions, we can distinguish between expression and communication.

Expression is in general a subtype of communication, in which, though, two conditions must be fulfilled: no meta-representation, and information on the system's mind.

1. A's signal is expressive if the goal of conveying information to others is at most represented but not meta-represented in system A, either because the signal is not consciously or deliberately displayed by A (take a young boy who blushes while seeing a girl but does not even feel himself blushing), or because it is displayed without the conscious intention of conveying belief C to B (e.g. a young girl who is blushing does not take into account that her blush makes her even more seducing). A's signal is communicative instead if A has the intention – a conscious goal, i.e., one meta-represented in the Sender's mind – of conveying belief C to B.

2. A's signal is expressive if the beliefs it conveys do not concern information on the World (Poggi 2007) but only information on the Sender – for example, A's internal states such as beliefs, goals, emotions. Therefore, a content concerning the location of food for the whole swarm can only be the object of a communicative signal; whereas the content concerning the stickleback's readiness to mating, expressed by his reddening abdomen (Tinbergen 1951), or the cry of a very little baby, are expressive signals.

So, as a first approximation, expression is a case of communication, but communication in a weak sense, where the goal of communicating is not meta-represented in the Sender's mind, either because it is unconscious or tacit, unreflected, or because it is not even an internal goal but, for instance, a biological function. Yet, in some cases expression is not even a case of communication, because it does not necessarily entail an Addressee, even less a goal of communicating something to someone else.

Suppose A, while coming back home very angry, slams the door. She only wants to give vent to her emotion, not necessarily does she want her mother to know that she is angry and why: her slamming the door is thus simply an expressive signal, but not addressed to anybody, hence not communicative. The Addressee and the goal of addressing are a necessary condition for communication, but not for expression: I may cry to communicate my sorrow to others, and this is a communicative cry, but I may also cry simply to give vent to my sorrow, and this is expressive.

We can then distinguish *expressive communication*, a kind of communication in a weak sense conveying beliefs on the internal states of the System in a non-meta-represented way, as opposed to *non-communicative expression*, where the System outputs one's internal state in an ego-centered way, just to give vent to it.

So, while beliefs concerning the world can only be communicated, beliefs concerning the system's internal states (physical and mental states, among which emotions) can be both communicated and expressed. But this means that in some cases an emotion or another mental state can be either expressed or communicated, and that the Sender may leave it ambiguous if s/he expressing or communicating, or may even express in order to communicate. Let see some possible combinations. A student waiting to take an exam who *smokes greedily* is a case of bare expression. But in a *young child crying* while doing whims, expression is aimed at communication. Yet, expression can also be faked: a *heartly smile* to a disliked colleague is in fact a deceptive communicative act exploiting a pretended expression. Finally, one can even pretend one is only expressing something in order to transmit some beliefs to another, but without communicating: take a woman who, in order to make her husband feel guilty, *pretends to be silently crying in her room, but leaves the door open* to let him hear: she is not communicating, at least in the strong (Grician) sense, since she does want to make him know of her sorrow, but she does not want him to know she wants him to know of it.

#### **4. A definition of sigh**

Once defined an expressive signal as one in which the belief conveyed is both not meta-represented and only concerning the Sender's internal states, we can transfer such distinction onto the vocal signal of the sigh: a sigh is an expressive signal whose breathing pattern simply displays some internal state – a physical

state like weariness, an emotion like sadness, or another mental state like giving up – but without its Sender having a conscious goal of making others know about such internal state. A sigh is communicative, instead, when its Sender has the conscious goal of having another know about the Sender's internal state.

Whether expressive or communicative signal, the sigh is a holophrastic signal (Poggi 1981; 2009), i.e., it conveys a meaning corresponding to a whole communicative act, including a performative and a content, where the performative is always one of information, while the content is an internal physical or mental state. Therefore, the semantic structure of a sigh is always either 'I feel internal state X' or 'I inform you I feel X', where X assumes the meaning of the different possible internal states. In fact, as already shown by Teigen's (2008) previous work, the sigh may convey several different meanings.

Yet in addition the communicative sigh, like any communicative act, besides its literal meaning may convey a further indirect meaning: a different meaning that may be inferred from the literal one. Suppose I am walking with a friend and I sigh, I may simply be expressing I am tired; but if I sigh while staring at him this may aim at communicating I am tired to him; finally, if I sigh after he has been blaming me for my past behavior, this might mean 'I am tired with you blaming me': then an indirect meaning of intolerance.

In this case expressing weariness is a euphemistic (then, rhetorical) way to convey some possibly much more rude information: *'I'm fed up with you'*.

To sum up, then, the sigh may be an expressive act, but also a communicative act, and in this case it may convey indirect meanings that go beyond (in some cases may totally contradict) the literal meaning of the sigh. This may account for the rich polysemy of the sigh resulting from Teigen's so diverse meanings: from a meaning concerning a physical state (like *tired*), one of mental state (*fed up*) can be inferred; from one implying low arousal (like *I give up*) an insulting hence very aggressive meaning may stem (*I give up because your stupidity is unamendable*).

In the following we present three studies investigating the meanings of the sighs and their perception.

### 5. Study 1. Sighs in literary texts

The first study we conducted was aimed at finding out the meanings of the sigh as they emerge from literary texts. As shown by other scholars (Poyatos 1998; 2000; Diadori 1990; 1997; Puig Rodríguez-Escalona, Fornés 2011) for gestures, studying the descriptions of bodily signals in written text may carry rich and detailed information about their meanings.

We collected a corpus of 64 fragments of literary texts drawn from novels by 10 Italian and 10 foreign novelists, the latter in an Italian translation, in which the root *sospir-* (= sigh in Italian) occurred one or more time. All the occurrences were singled out, whether verbs (like *sospirò* = s/he sighed, *sospirando* = sighing), nouns (*sospiro* = sigh) or idioms (*tirò un sospiro* = he took a sigh). For each occurrence we provided a verbal paraphrase of the meaning that item expressed or communicated in that context, then translated into a nominalization of the internal state conveyed. Table 1. presents the results of our analysis.

CATEGORY	INTERNAL STATE	N.
WEARINESS	<i>Fatigue</i>	2
SADNESS	Displeasure	15
	<i>Regret</i>	3
FRUSTRATION	Annoyance	3
	<i>Exasperation</i>	2
GIVING UP	Resignation	13
OTHER NEGATIVE EMOTIONS	Fear	2
	<i>Worry</i>	7
SATISFACTION	Relief	4
<i>LONGING</i>	<i>Desire</i>	4
	<i>Hope</i>	3
	<i>Preparation for action</i>	2
<i>PHYSICAL</i>	<i>Expiration</i>	3
	<i>Inspiration to talk</i>	1
Tot.		64

Table 1. Sighs from literary texts  
Teigen's categories in round; New categories in italics

As results from Table 1, our analysis in a great part confirmed Teigen's findings. In the literary texts of our corpus, the sighs mostly convey the very same internal states as predicted by Teigen, also often groupable in the same categories. For instance, we too found *relief*, within Teigen's category *Satisfaction*. In other cases, though, we found slightly different states, even if corresponding to his categories: for example, within the category *Frustration* we found *annoyance* and *exasperation*. Yet, we also found two more categories: a *physical* one of sighs used as a bare description of breath processes, like taking a sigh before starting to speak (*inspiration to talk*), and one we call *longing*, of sighs conveying positive mental states like *desire* and *hope*, plus a *preparation to action*: some states that are not only positive (like *relief*, already mentioned by Teigen), but also projected to the future.

## 6. Study 2. Sighs in TV and movies

As follows from our definition of sigh and from results of Study 1, the sigh always expresses or communicates internal states of the Sender: a physical state like weariness, a mental state like a desire or a decision to give up, and finally positive emotions like relief or negative ones like sadness or resignation.

In a second study, we collected a corpus of 100 videos, taken from movies, tv fiction, cartoons, talk shows and political debates, in which some characters or debaters sigh during interaction. In this corpus too we generally found the very same types of meaning as those of Teigen (2008) and of our Study 1; within our category *longing*, the sigh of *preparation to action* was specified into one of 'self-encouragement', that we observed in case of preparation for an effort, either physical or mental. Here the sigh seems to work as a preparation to engage in a new endeavor: taking a breath before a new start. On the other side, we realized that in a great part of political debates the sigh, mainly due to its indirect meanings such as 'I am tired (of listening to you)' or 'I resign (because you are unamendable)' has the function of a body comment aimed at discrediting the opponent by implying s/he is boring or stupid.

By *body comment* we mean, after Poggi et al. (2013), a communicative act performed during an interaction by a participant who is not at the moment entitled to have the turn, and therefore cannot communicate not by words but does so by body signals; such communicative act during the interlocutor's or a third party's

turn can be defined a comment when the provided information is pertinent with the interlocutor's present turn, but not requested by it (not, for example, an answer to a question, nor a backchannel), and when it conveys an evaluation or other information facilitating the interpretation of the addressed turn.

Let us take a sigh performed as a body comment during a political debate:

(1.) <https://www.youtube.com/watch?v=X2XPD4Y6gs4>

Laura Boldrini, the leftist Chair of the Italian Chamber, while talking of the boat people arriving on the Italian coasts, argues against her present opponent Matteo Salvini, the rightist leader of the North League, claiming the necessity to push them back, that this situation is the fault of the previous policy of the right government.

During her talk, Salvini performs an *audible inspiration* while *rolling his eyes up*, then he *points his eyes again to the camera* with his *eyelids half open*, making an *audible expiration*.

This sigh looks as a signal of impatience and intolerance addressed to Boldrini's complaint.

This type of sigh, working as a flaunted expression of annoyance and intolerance, is very often exploited in political debates as a 'discrediting body comment' (Poggi et al. 2013), i.e., a way to express one's negative evaluation of the opponent's discourse by simply displaying facial expressions or other body signals as a 'silent' feedback provided to the audience during the present speaker's turn. Quite frequently, while politician A is talking, the opponent B must leave him/her the turn, but taking advantage of being presently video-recorded by the camera, s/he launches seemingly 'silent' messages to the audience, thus implicitly or explicitly displaying her/his disapproval through expressions of boredom or annoyance, for instance by *rolling eyes*, *looking up in the sky*, *tossing head*, or just *sighing*. In this case the sigh has a literal meaning of frustration or boredom, but the expression of this emotion is aimed at letting the audience infer negative evaluations about the opponent: by expressing frustration one may imply the other (or his/her present discourse) is so stupid as not to be amendable; by expressing boredom, one may imply that the person or the discourse are repetitive or pointless.

### **7. Study 3: a perception study on sighs**

To further investigate the meanings of the sigh, and specially of this peculiar ‘discrediting sigh’ among others, we conducted a perception study.

#### **7.1 Hypothesis and method**

The goal of our study was to check if people viewing and listening to different sighs can attribute them different meanings, and if these meanings are shared among judges in the particular context of political debates.

In order to a preliminary check of Teigen’s (2008) taxonomy of meanings in the context of political debates, and to select the subset of meanings to submit to participants in our study, 55 different sighs, all taken from Italian political tv-shows, were analyzed by two independent judges. Within these, to better adapt the list to interaction in the political context, that is typically not so placid or relaxed, we only selected 8 items: 6 out of them correspond to Teigen’s categories, while we excluded those with a positive valence (happiness and empathy) and, for balancing reasons, his category of ‘other’ negative emotions (jealous, afraid, nervous, envious, hungry). Instead, we included the new positive category of self-encouragement found in the preliminary corpus analysis, to assess, through our perception study, if this is actually a possible meaning of the sigh. Finally, as a control item we included a case in which no sigh was produced in fact.

Thus the selected items, besides the no-sigh one, included sighs of frustration, boredom, weariness, giving up, satisfaction: states with different combinations of valence and arousal. Finally, some items were deliberately ambiguous among 2 meanings.

#### **7.2 Participants and procedure**

64 participants, 34 from USA and 30 from Italy, were recruited through an online campaign and submitted with a survey in which they had to watch 8 different videos taken from Italian political debates, 7 of which contained a sigh. Participants from the USA were asked to rate their level of understanding of Italian. After watching each video, both Americans and Italians were presented with the list of Teigen’s meanings, with the addition of ‘self-encouragement’, and they were asked to tell, on a 7-points Likert scale, how much each of those meanings could be plausibly correspond to the sigh in the video.

### 7.3 Results and discussion

As results from Table 2., the sighs of frustration, self-encouragement and boredom were quite frequently recognized as such by participants, while those for giving-up, weariness and satisfaction elicited sparser ratings. The lower ratings of the control item reveals that participants can tell the difference between what is a sigh and what is not.

	Stimuli						
	Frustr	Give-up	Weary	Satisf	Self-enc	Bored	No sigh
Sadness	2,36	2,58	2,28	2,16	1,89	2,30	2,39
Giving up	3,91	4,23	3,69	2,66	2,50	2,97	2,91
Weariness	3,61	4,25	3,80	2,70	2,58	3,38	2,81
Boredom	3,88	4,20	<b>4,05</b>	2,27	2,56	<b>4,06</b>	2,67
Frustration	<b>4,64</b>	<b>5,44</b>	4,02	<b>3,66</b>	2,78	3,20	2,77
Satisfaction	1,70	1,67	2,27	2,77	2,77	2,28	2,23
Relaxed	1,80	1,73	2,30	2,30	3,11	2,55	2,20
Self-enc.	2,41	2,25	2,44	3,45	<b>3,38</b>	2,23	2,72
Other	2,14	2,16	2,13	2,72	2,44	1,95	2,33

Table 2. Participants' interpretations  
Stimuli in columns, interpretations in rows

Moreover, also when the specific emotion is not recognized, participants generally correctly rate the sigh in terms of the dimensions either of valence (e.g., frustration perceived as giving up), or of arousal (e.g., boredom perceived as relax). Sighs conveying negative valence are perceived as negative in any case, but they are seen as more so by Italians slightly more than by Americans (positive valence Italians mean = 0,24; positive valence Americans mean = 0,34; negative valence Italians mean = -1,81; negative valence Americans mean = -1,26). In Fig.1, on the x axis we labelled each video as +, - or 0 depending on our hypothesis on the relative valence conveyed by its sigh; on the y axis we listed the mean of a composite score showing the level of valence indicated by participants; as can be seen, they answered coherently with our hypothesis.

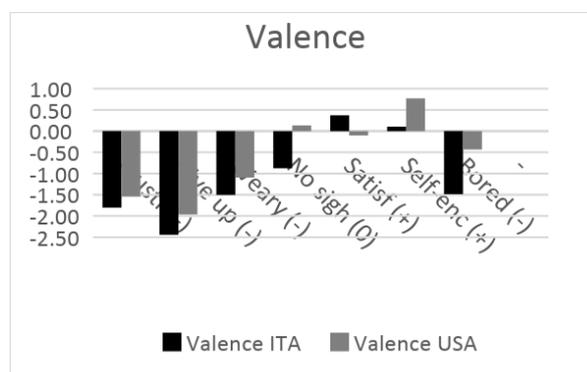


Figure 1: Valence for ITA vs. USA

We think that a more frequent attribution of negative valence to sighs in the videos on the part of Italian participants might not be due only to mere language competence, but rather to cultural knowledge in a broad sense: in most videos the Senders of the sighs are some politicians (e.g., Matteo Salvini) or journalists (Marco Travaglio) that are known to be particularly sarcastic. To this we might add also possible personal and political affinity of Italian participants toward the speaker or the 'sigher' in the debate, that might have influenced their interpretation of the sigh meanings, by viewing them as more or less aggressive than Americans did.

As regards the *self-encouragement* sigh, Italian participants generally tend to recognize it; the same cannot be said for Americans, who preferably rate it as conveying relaxation and satisfaction (still positively valenced meanings) [Fig. 2].

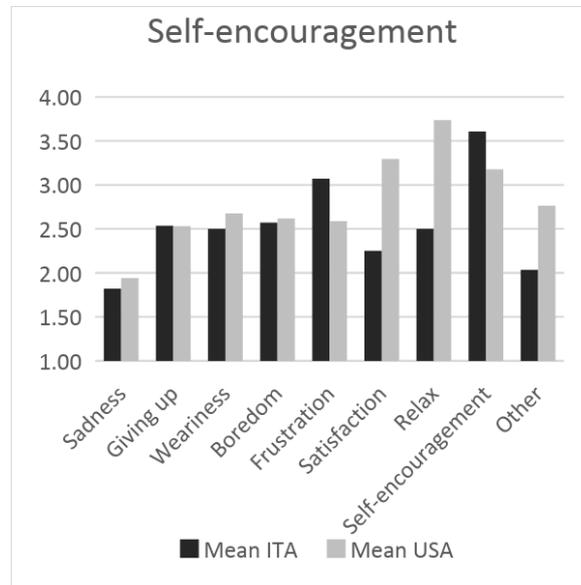


Figure 2: Self-encouragement

### 8. Sighs: along the route of our desires

The meanings of the sigh found out by both Teigen's and our three studies are seemingly very different, and they range from positive to negative feelings, from arousal to depression; yet, if we try to group them we discover that they are not so incongruent with each other, and that the sigh always expresses or communicates mental states which we may put in a sequence: in some sense they scan the path going from the outset to the end of the process of goal pursuit, accompanying all its phases and possible outcomes. Let us follow the steps of the 'route of desires'.

As soon as a goal becomes salient, a mental state of *desire* is felt. In Miceli and Castelfranchi's terms (2015, 6), desires are «goals whose attainment is viewed as not impossible». This very assumption of that goal as being potentially attainable makes room for the emotion of *hope*; but at the same time the fact that the goal is still being pursued gives rise to a sort of self-encouragement of the subject to oneself: *self-encouragement*. The sighing person is in a certain sense taking an intense breath in order to store the energy s/he will need in this possible but difficult goal pursuit. To encourage oneself can be defined as communicating to oneself in order to convince oneself one has the power to attain the goal, so s/he must really strive to achieve it.

If the goal is attained, then two kinds of sigh can be performed (in which, very likely, the expiration is more salient). The

first one is a sigh of *satisfaction*: the emotion one feels when assuming that a goal one intensely desired to attain is finally achieved, and mainly thanks to one's own skills and merits.

Subsequently, or at the same time as satisfaction, after goal achievement one can feel *relax*: the feeling one can finally rest right because the state one wanted to bring about is now actually realized.

Now suppose that about the goal one is presently pursuing one has some negative expectation, so much so as to lose hope in its achievement; in case suddenly that desired state gets realized, the subject may feel *surprise*, amazement: a 'cognitive' emotion (Poggi 2008; Miceli, Castelfranchi 2015) that gets coloured with the positive feeling of *relief* if the expectation of failure had been so high as to cause anxiety.

Suppose instead that about a pending goal one has no expectation of failure, but the goal is unexpectedly thwarted; this would typically trigger an emotion of *disappointment*.

Besides the goal, the subject's assumptions about likeliness and causes of its achievement are salient to elicit a sigh. If attainment is believed as objectively almost impossible, a sigh of *vain hope* may be issued; if one thinks it is not attainable by oneself due to world conditions (or even to one's lack of necessary skills?), a sense of *impotence* may be expressed; and after acknowledgement of one's impotence, one may sigh for *resignation*: the negative mental state following the decision to *give up* to some goal.

If one believes it is possible to attain the goal but, while striving to get it, finds more effort is still required to achieve it, one may feel sensations of *effort*, that is, of striving while being at the top of one's skills; of *fatigue*, i.e., feeling one is almost exhausting one's energy. These two states are present when the level of activation is still high, but when trust in one's capacity and possibility of achieving the goal and consequent activation decline, *weariness* is felt, and expressed by a sigh. Finally, when the situation of striving and not succeeding is enduring, and nothing new happens, *boredom* is felt, the emotion triggered by an assumption of lack of novelty.

If the goal is thwarted (or in so far as it is not achieved), the subject may perform a sigh of *frustration* – the feeling monitoring goal failure – and possibly of *annoyance*: an emotion from the family of anger, therefore one of negative valence and moderate-to-high arousal.

In this case, if the subject assumes that goal achievement is prevented by other people, and wants to communicate one's own frustration or annoyance, the sigh may express *flaunted boredom*, a communicative act through which the subject, while displaying the low arousal negative emotion of boredom, by the rhetorical device of euphemism in fact indirectly communicates (wants others to infer) one's *intolerance*: a negative social emotion of a higher level of arousal.

Finally if, assuming that the thwarting of one's goal is due to another person, one has the goal of aggressing him/her, but at the same time, for whatever reason – again euphemism, politeness, opportunity or opportunism – also has the goal of inhibiting one's aggressive action, then the sigh may display or flaunt self-restraint, i.e., the goal of *refraining from aggression*, and in some case even flaunt one is *giving vent* to one's own arousal, to avoid actually aggressing the other.

### **9. Conclusion and future work**

The sigh is a highly polysemic signal, and its multiple meanings are not easy to distinguish; yet participants in our perception study differentiate positive from negative, and high from low arousal sighs. Future research will try, first, to set a clear distinction, in terms of physical production and intended meanings, between sighing and other vocalizations like sobbing, panting, puffing or snorting. Then, the correspondence will be investigated between the physical production of sighs and their respective meanings, checking for instance whether the audibility of inspiration and expiration correlates with different interpretations, and what meanings are added by its combination with other body signals, such as rolling eyes, head shaking, raising head, opening arms.

### **Acknowledgments**

The work is partially funded by the Italian National Project PRIN 'Cultural Heritage Resources Orienting Multimodal Experiences (CHROME)' n. 2015WXBPYKCHROME.