Misunderstanding and Risk Communication in Healthcare

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Abstract

Risk communication is one of the most delicate dialogues within the healthcare domain. Such delicacy is given by the nature of the topics treated within these dialogues and the easiness with which misunderstandings between doctors and patients may occur. Hence, one of the main challenges is to enhance doctors' awareness of implicit understandings between doctors and patients in the context of pre-operative communication of risks. In this paper, we intend to shed light on this topic, poorly investigated in the literature, by starting from the perspective of the philosophy of language, in particular pragmatic analysis tools that make the implicit understandings of the interaction explicit. We analyze actual cases involving evaluation before cardiac surgery from a philosophy of language perspective. Then, we demonstrate on the dataset we collected, how available state-of-the-art models are far from reaching acceptable performance in detecting misunderstandings within healthcare-wise dialogues. Finally, we conclude the paper by tracing a possible research direction on this topic.

Keywords

Risk Communication Misunderstanding Dialogues Digital Health

1. Introduction

Risk communication is one of the most controversial and debated issues in the context of doctor-patient interactions [2]. Even if medicine is an evidence-based science [3, 4], it is not an exact science [5, 6] and it involves uncertainty and probability [7, 8]. When doctors communicate with their patients in a formal setting, the doctor has to convey information to the patient concerning the prospect of success, possible complications, and side effects. Such communication involves uncertainty because medical information is for the most part based on probabilities, not certainties. There is always a degree of risk in medicine: the risk that the patient will not respond well to the treatment, the risk that something will go wrong during the surgery, and the risk of complications during recovery [9, 10]. The risk ratio is always to be taken into account in evaluating the patient's best interest, and the more significant the risk the more important its communication. For example, in comparing treatment for a rash to a surgical operation, it is more important to know the balance of risk in the latter. Attempts have been made to categorize the uncertainty on the basis of medical risks. Citing [11] claim that uncertainty derives from source, "incomplete information, inadequate understanding,

or undifferentiated alternatives of equal attractiveness", or issue, "the particular outcomes, situation, or alternatives to which a given uncertainty applies" [11, 12]. Weinfurt adds to Miller and Joffes' categories of uncertainty, "the causal agent and the validity of surrogate endpoint", "uncertainty about generalizability", meaning "using data from past studies to predict what will happen in a new" one; the "estimation error" associated with statistics; and the fact that any estimation is "characteristic of a population, not of an individual" [13]. Discussing benefits in phase 1 oncology trials, Miller and Joffe conclude "in order to facilitate informed consent, it is vital that clinical investigators communicate meaningfully to patients regarding the probability, magnitude, and duration of potential benefits and risks, along with their attendant uncertainties" [14]. As Weinfurt points out, this is not so obvious, both because it requires doctors' clear knowledge about benefits and risks, which is itself based on uncertainty, and the patient's understanding of doctors' disclosure (see [15] study about this topic). This second point is especially compelling from our perspective of analysis because it involves not only the content of communication but also the way of communicating. Communicating the risk to the patient requires certain skills, as it is a sensitive moment for them: they have to face the risks, including sometimes the risk of death. This is a topic of great interest to psychologists, as it involves the emotional aspects of the interaction: communicating properly means not being traumatizing [16], and good communication also helps build a relationship of trust between the doctor, the patient [17, 18], and the family [19]. Some psychological studies show a direct connection between the communication of risk and the level of trust in the doctor-patient relationship [20].Some articles talk about risk communication in a broader discourse, particularly as part of obtaining informed consent [21], patient's rights [22], and the physician's duty to tell the truth [23]. These issues have also been investigated by philosophers, specifically in clinical ethics and bioethics [24].There are also relevant applications of the philosophy of language analysis to this topic [25, 26]. As I have discussed, a philosophy of language analysis explores the implications of what is said. This could help to identify which kind of implicature is fruitful and which one is harmful [27]. Applied to the doctor-patient interaction at the moment of risk explication, this analysis could help improve the awareness of speakers and thus doctor-patient communication itself.

In this paper, we will introduce the challenge of misunderstanding detection during risk communication dialogues in healthcare. Overall this research topic has been poorly addressed in the literature due to the scarce availability of resources and the difficulty of the task [28, 29, 30]. Firstly, we will discuss such a challenge from a philosophical perspective by analyzing the implicit dimension of dialogues and trust. Then, we will detail some use cases extracted from the dataset we used to perform a preliminary classification of the text with respect to the different types of misunderstandings we identified in the analyzed dialogues. The set of possible types of misunderstanding used to annotate our data followed the codebook described in [31] that specifically addresses the topic of risk communication in healthcare.

2. The Implicit Dimension

The implicit dimension of discourse is full of meaning, and philosophers of language are committed to demonstrating it. Grice is the first to call the implicit dimensions of the discourse

'implicatures' [32]. According to the Stanford Encyclopedia of Philosophy, "implicature denotes either (i) the act of meaning or implying one thing by saying something else, or (ii) the object of that act". If I ask someone 'Do you know what time it is?' I expect an answer like 'Noon' or 'It's late', and not the answer 'Yes'. The implicit meaning could be that I do not know what time it is and I am asking someone to know it; or that I want to know if I am in time and my interlocutor replies that I am not. My question is the same but conveys two different meanings. As we can notice from this example, the Gricean implicatures do have a functional role: it is not only what we say, but also what we do not say that makes the conversation effective, or not. We can distinguish two main kinds of implicatures: (i) the inevitable one, (ii) and the one related to speakers' choices. Both are context-related and necessary. The (i) first one is the implicature that makes the conversation work; for example, if the doctor offers the patient 'some water', they do not have to specify what water is, in which kind of glass it will be served, and in which state. It would be simply incredible for the patient to receive an enormous container of pink ice. This is a so-called 'convention' or 'conventional implicature' between the speakers. Nonetheless, we have to keep in mind that these conventions change from one culture to another, i.e., they work in proper circumstances and do not in others (see the concept of felicity in Austin 1962). This could generate difficult or even amusing circumstances: e.g. if you nod in Greece to show your enthusiasm for having that glass of water, you are actually refusing it (see the concept of infelicity in [33]). There are also more specific conventions: for example, if the patient asks her doctor how Luke is, she does not have to specify that she means the doctor's son, the doctor's husband's child, or the brother of the doctor's daughter. It is clear why it would be impossible to communicate if we were always to explain everything. The (ii) second kind of implicature is more complicated, as it does not derive from a spontaneous simplification of the communication. It depends on the speakers' choices, and it could be related, for example, to obviousness, complexity, and time: the speaker chooses not to say something. If a dermatologist asks a patient "Please, bring me your exams tomorrow", the doctor is not saying tomorrow when, where, which exams. The implicatures of the dermatologist's request are tomorrow at the time of the appointment they just made, in the doctor's office, and the skin pathology exams. This last implicature is not as obvious as the others: it will be no surprise to see a patient bringing the whole documentation of their healthcare history to the medical examination. This second kind of implicatures is case-specific, as opposed to conventional ones; Grice called them 'conversational implicatures'. The main difference between these two kinds of implicatures is the hidden nature of the second one, in contrast with the clarity of the first; in both cases, what is said is intertwined with the unsaid. Rewriting the implicatures strongly related to the speakers' choices requires more accurate tools. Despite Blečić's suggestion [34], we do not think it is possible that "both doctors and patients should avoid conversational implicatures", as I believe implicatures are an unavoidable piece of meaning in communication, while I agree with her when saying that "both parties could benefit from the ability to detect them". The philosophy of language makes the effort to structure the interaction, making explicit the unsaid, and in doing so makes clear which are the gaps and misunderstandings to be corrected. Making explicit the implicatures of the doctor's communication with the patient will allow us to identify the specific problems that occur by way of missed or misunderstood meanings, and create a map of the interaction.

3. The Implicit Dimension And Trust

According to Grice, the basis of all conversations is the cooperative principle. He means that being cooperative in recognizing a common aim is fundamental to understanding the other person during a conversation. This cooperative principle fits well with Wittgenstein's thoughts on the topic. Wittgenstein (1953) tells us that every speaker has a set of rules for speaking, which he calls a "language game". We use our language game to speak with others, and this immediately brings out an uneasiness about speaking, because during a conversation there is a minimum of two different language games dealing with each other. It is impossible to fully know the language game of the interlocutor because most of the rules are unsaid: as much as none of us explain the grammatical rules we are using while speaking, it happens for all of the other rules Wittgenstein is talking about. We can imagine that a third language game has to emerge [35]: this is the set in which two or more different speakers can meet, sharing common rules in a workable compromise. In the specific case of doctor-patient communication, we have two main systems of rules (the doctor and the patient), which are meant to meet in the third set, the figurative space of the doctor's office. It is necessary for the speakers to be willing to mutually accept the rules of the language games in play. If we combine Grice and Wittgenstein, we can say that communication needs to be based on reciprocal trust (as Grice's cooperative principle claims), and the speakers should share and accept the rules at play to make the communication effective. Referring to doctor-patient interaction, we will see how shared rules and reciprocal trust are the basis of a solid therapeutic alliance. In pursuit of this goal, the speakers have to follow four axioms to make the communication effective, the so-called Gricean maxims. They are: (i) maxim of quality: be truthful; (ii) maxim of quantity: make your contribution as informative as is required, and not more so; (iii) maxim of relation: be relevant; (iv) maxim of manner: be clear, avoiding obscurity, ambiguity, prolixity, and disorder. There are particular cases in which the speakers violate these maxims not to flout the cooperative principle, for example when using metaphors, irony, and hyperbole. I believe that, even in such cases, having in mind the Gricean maxims is helpful to fulfill the interlocutor's expectations and keep in mind the thread of the discussion. We thus obtain a linguistic universe ruled by (i) what is said, and (ii) the implicatures, as even if you can't see them, they are meaningful. If we combine this with the four maxims, we can say that trust is the foundation of communication, not only regarding the activity of the speakers (maxims) but also the inactivity of the speakers (implicatures). The implicit dimension is the unsaid. Nonetheless, it is full of meaning and it forms part of the creation of the general meaning of a conversation. It is clear that it would be problematic if the implicit dimension of any communication were related to mistrust instead of trust. Imagine asking your housemate if he has locked the apartment. If he replies "Yes", and you trust him, the communication will end. On the other hand, if you do not fully trust him, maybe because you know he is a moody or unreliable person, you might go on questioning him: "Ok, but have you double-locked it? And have you closed the door with the latch, too? Have you set the alarm?". If we apply this strong connection between the implicit and trust to the doctor-patient interaction, we can immediately notice how problematic it is. Imagine, for example, a doctor who does not trust a patient evaluating their compliance: "Have you taken your pills? I mean, every day? And, all the five of them? After dinner, as I suggested?". This quite absurd scenario seems to be an interrogation instead of a clinical consultation: the

example stresses the centrality of trust, and the problems attending its lack. This is especially true at the moment of risk communication.

4. Risk communication: trust and truth

We have learned that communication is effective when based on reciprocal trust. The same is true for doctor-patient interactions and, more generally, for the doctor-patient relationship [36, 37]. As we previously mentioned, trust is essential in creating a solid therapeutic alliance. Starting from the Gricean maxims, we can picture the therapeutic alliance as a virtuous circle between trust and truth. The meaning of the noun trust ("the belief that you can trust someone or something") becomes clearer when looking at the definition of the verb "to trust": "to believe that someone is good and honest and will not harm you, or that something is safe and reliable; to hope and expect that something is true" (according to the Cambridge Dictionary). Trust is usually a three-sided relation: "X trusts Y to do Z". This is translatable in the clinical setting to "P trusts D to do X" and "D trusts P in doing X". Likewise for the meaning of the noun truth ("the quality of being true") with the definitions of its respective adjective true: "sincere or loyal, and likely to continue to be so in difficult situations" and "having all the characteristics necessary to be accurately described as something". As we can notice from the italicized words, there are two main common points in the two definitions: (i) true, sincere, or loyal; and (ii) accurately described. The (i) first cluster is related to the reliability of the relationship, which has to be based on truth to be trustworthy, and vice versa. The (ii) second part is focused on the necessity to describe, i.e. to have arguments about the object of the relationship (e.g. in the clinical setting, a particular treatment). This definition isolates a problem directly connected with risk communication: it is indeed not always possible nor productive to be accurately descriptive when the subject of the communication is something open-ended like risk. On the other hand, certain kinds of omissions could be problematic, too, even though "the desire to establish trust can conflict with the imperative to disclose the whole truth" [38]. We can see how difficult it is to make the virtuous circle work when the truth has to cope with expectations ("...will not harm you..."), and with uncertain communications.

5. The doctor and the patient

As Wittgenstein taught us, before being two people in communication the doctor and the patient have two individual language games, i.e., two different systems of rules. On the one hand, the doctor is a professional, generally wearing a white coat, and uniform, and writing information about the patient in a medical record. On the other, the patient is usually sick, not wearing a uniform, and their symptoms are not always visible. Therefore, the two main systems of rules in contact are a professional and a sick person, but what does that mean? On one side, the doctor is professionally responsible for the patient's life in the terms established by law and deontological codes; on the other, the patient is responsible for their own life, relying on the doctor to preserve it. In this context there are two levels of communication involved: (i) the professional level and (ii) the personal level. The professional level is the one that relates to the profession of the doctor, who represents the expert in the interaction. The doctor has the duty

to communicate information about the pathology, quality of life, treatments, and risks. The personal level has to do with the emotional aspects and the history of both the persons involved: it is the place in which fears, doubts, and humanity exist. These two levels are connected: the patient is involved on the professional level as a passive subject and the doctor as an active one, while both of them are active subjects on the personal level. We can notice here a double asymmetry: the patient is never on the professional level; the doctor and the patient are both on the personal level implied in the relationship, but not in the same way. The first asymmetry is the well-known asymmetry generated by the difference in knowledge between the doctor and the patient: the doctor is the specialist who knows the medical subject in terms of medical discipline and the patient's body. The second shows the doctor as a person: they have to stay in the professional role, respecting the professional boundaries of the relationship, but at the same time the doctor is a person with a personal implication. This twist has its mirror in the law: when the professional responsibility of the doctor results in a criminal offense, it becomes a criminal responsibility (see the Italian law "Gelli-Bianco" n.24/2017). This brief overview highlights only one significant side of the complexity of doctor-patient interactions: it shows us that risk communication does not take place in a neutral setting. Once a doctor, frustrated about a non-compliant patient, cried: "If the printer is broken I call the guy who fixes it to fix it, and I do not claim to teach him his job, because it is his job, and I know nothing about it!". The exasperation led the doctor to put in brackets the far more intricate nature of the medical subject: the patient is definitely not comparable to a printer. However, the doctor's exclamation confirms that their personal involvement is strong, and sometimes even dominant.

6. Case Analysis

We present below five cases extracted from our dataset (see Section 7) and we analyze them in more detail aiming to show and discuss how misunderstanding may occur in risk communication and which consequences they may have [39].

CASE 1: DNR order The anesthesiologist, a woman in her forties, is talking with a man in his seventies about a possible surgery due to his aortic aneurysm.

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D: They told me you decided with the surgeon.
P: Well, 'decided'... I can only give my willingness; it's you who decides.
D: I can tell you that this surgery is very risky in a small percentage of
cases... the problem is in this minimum percentage of cases there would be
no indication to take you to the ICU. This means that we put in a tube that
we would unlikely take out. When you have self-suspended the therapy... you
are a delicate patient in many ways... what I want you to understand is
that your risk is to lose a lot of autonomy. ... It's up to you.
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As we see, there is clearly something that the doctor is not explicitly saying; not that she is not saying anything, but she is not saying something specific. The central piece of information here is "There would be no indication to take you to the ICU", which in other words means that in case of complications, the patient would not be resuscitated: he has to know that the mortality

risk of the surgery is higher than usual for him because of this decision. Let me emphasize that the doctor chooses an expression that is evocative, "There would be no indication..." instead of saying sharply "You won't be taken to the ICU". But why the decision, and who made it? The doctor uses two key phrases: "You have self-suspended the therapy", and "You are a delicate patient in many ways". The odd phenomenon is that these phrases seem to be contrary: the first is a reprimand, and the other focuses on patient care. It seems there is a lot here that is not explicated and generates confusing communication in conveying a message. The physician is trying to say something without being direct. The patient, who is a delicate one (see below), does have a fault: he self-suspended the therapy. The patient's compliance is necessary to make therapy successful, and when compliance stops the treatment fails. Besides, a non-compliant patient represents a hindrance in the therapeutic alliance that is based on reciprocal trust [40], and a non-compliant patient seems not to be a trustworthy person. The physician here is saying without saying explicitly "How can we still trust you?", and this strong concern is at the same time strengthened and softened by the following: "You're a delicate patient". Again, what does this mean? How do we have to unfold the meaning of the word 'delicate' in this context? Unfortunately, there is no way to reach a satisfying interpretation solely on the basis of the interaction. The solution is in the patient's medical record, in which we find that he has advanced lung cancer. Going back to the opening, we read again "You decided with the surgeon" that now turns out not to be an assertion but rather a questioning of this decision. The combination of two implicit pieces of information, the lack of the patient's compliance and his severe disease makes the "loss of a lot of autonomy" extremely likely, and the prospect of the patient's death closer than ever. The final physician's remark reveals a tension in the clinical decision that cannot only be referred to the surgical risk: she says "It's up to you" in direct opposition to the patient's "It's you who decides". In fact, doctors have already decided not to take him to the ICU: we can see the hierarchy of knowledge linked to decision-making power. The anesthesiologist knows the extent of what she is saying and defers the final decision to the patient: she together with the surgeon is giving the rules and the patient can only decide to be in or out. There is a clear failure in creating a third common language game.

CASE 2: Death instead of pain?   An old man is in his eighties, talking with the anesthesiologist in her forties, and asking for further details about the risks involved in the removal of an aortic aneurysm. The discussion is difficult: the patient is quite old and the doctor struggles with what decision to make. She has previously consulted the surgeon, too. The clinical condition is delicate: operating on the patient is risky but not doing so leaves him with an aortic aneurysm, an extremely dangerous pathology.

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D: Unfortunately, it's a bet. I don't know you; it depends on your outlook on
life. I barely know what I would do if it were me, but I'm not even sure. ...
you won't feel pain, this I guarantee you, regardless of whether everything
goes well, or you don't wake up.
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Despite the many implicatures we can highlight here, there is a phrase with a strong impact: "or you don't wake up". Now the patient is aware that death could be the result of the surgery, and not a distant option either concretely or in terms of time. Even so, if we come back to

the beginning of the physician's discourse, we read, "it [the surgery] is a bet". What does that mean? At first sight, we are tempted to simplify and trace it back to the high risk of it. As we already said, however, the doctor is saying something more. In this context, placing a bet has the same meaning as playing dice. The physician could not base her decision on reliable statistics or a certain percentage of risk: this happens when performing surgery is as risky as not. She is telling the patient that his condition is fatal: there is no possibility of predicting which way is safer for him. The only thing she can promise is that he "won't feel pain" if he chooses to be operated upon, the only path in which the anesthesiologist could be with him. She is trying to reassure him: this highlights her attention to the emotional dimension, i.e., the patient's fear, which although unsaid is strongly present. In fact, since she does not have a clear standing as a doctor, she switches to her personal view ("I barely know what I would do if it were me") positioning her perspective on the same level as the patient's one.

CASE 3: A dangerous surgery

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P's wife: Is this surgery dangerous?
D: Yes, of course, it is, Ma'am... What do you mean by 'dangerous'? What do
you want to ask?
P: She's asking about my life.
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The patient is a man in his sixties, accompanied by his wife, and he is in the anesthesiologist's office to schedule a carotid artery revascularization. In the Pulitzer Prize for Drama winner play W;t, we find a passage along the lines of this case. Vivian Bearing, the main character, has been diagnosed with advanced metastatic ovarian cancer; his doctor, Harvey Kelekian, is telling her that the cancer is spreading and that it is an insidious one. "Insidious?" asks Vivian to Dr. Kelekian, who answers, "Insidious means undetectable"; "Insidious means treacherous", says Vivian [41]. The physician's language is different from the patient's one. It is evident when it is about technical terms, and the medical language is far from a layperson's world of knowledge (see [42]). Sometimes, however, this kind of misunderstanding happens with non-technical terms. In this case, the adjective 'dangerous' is the word responsible for the misunderstanding. "What do you mean by 'dangerous'?" asks the doctor, even if it seems a simple word with a conventional definition: something able to harm you, causing unpleasant problems or even death. Nevertheless, in the particular framework of risk communication the word 'dangerous' means something different than usual. As we saw above, every kind of medical act involves a risk ratio. Depending on the context, the question arises whether it is worth communicating or not. From the physician's perspective, or we could say in the physician's linguistic world, the patient's question is rhetorical: surgery is always 'dangerous', as it always implies some risks. The signifier 'dangerous' called for different significances in the patient and wife's and in the doctor's universe of meanings. From the patient's perspective, a world that is not only linguistic but also strongly emotional (and confirming this it is the patient's wife who asks), there is no pretense in dwelling on doubt recalling serious consequences, and even death. Indeed, the patient explains: "She's asking about my life", which is at stake.

CASE 4: No implicatures, please   The doctor-patient interaction is full of implicatures, both in the sense that every kind of interaction is, and in a strictly contextual one. Nonetheless, it

happens that some patients openly demand 'no surprises'.

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P: Come on, come on, I don't care, is it a difficult surgery? What do I risk?
Will I die? Nooo...
D: You want to know what I think? The surgical risk doesn't mean anything if
your case is the wrong one. But we're not crazy, we suggest you do it
because the risks are less than if you do not do it. ... The moment has come.
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The patient, a man in his seventies, asks the doctor, a woman in her forties, to be crystal clear. She replies in a way that only appearance is as direct as his, but she actually does not answer any of his questions. She is doing two things at the same time: (i) she is showing him the worst-case scenario ("...if your case is the wrong one... but we're not crazy"), in what seems an attempt to reassure him; (ii) saying "the risks are less than not to do it", like the previous case, she is revealing that risks lie in the surgery as well as in the patient's condition. She finds a way that allows her to satisfy the patient's question while preserving the uncertainty of the risk dimension. She is able to do this thanks to her viewpoint, which is border than the patient's one. Nonetheless, this broader viewpoint is exactly what the patient is asking for. The patient is making a clear statement: he wants to know; he does "not care" about the redundant data and needs to have a full picture. In this case, to preserve the therapeutic alliance, i.e., the patient's trust, should the doctor be frank? The reflection on candor in the doctor-patient relationship has its own flourishing literature (see [6]), and it raises the main question that leads the discussion: how candid is a doctor supposed to be? The patient's desire for absolute answers, and to know about the nature of the risk, generates a delicate dialogue. The physician tries to release the tension with a declaratory closing sentence ("The moment has come"), eventually reaffirming her authority.

CASE 5: To do or not to do

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D: The mortality risk of this surgery is between 0.9% and 1.6%. If you are
not going to be operated on we won't have a numerical value, of course.
P: That's what I asked for but nobody can answer!
D: There's no IRB that would ever approve a study to see how likely a dying
patient will die...come on, please.
P: Yes...I guess not even Jesus Christ knows that.
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A man in his forties is listening to another man in his forties, but they are on very different levels: the first is a patient scheduled for an aortic valve replacement, and the second is the anesthesiologist. The physician is describing the surgery, including risk factors, and trying to be highly accurate: he uses a specific range ("between 0.9% and 1.6%") to show the patient robust data, according to the evidence-based medicine values. Regrettably, we have to admit that the doctor's language here is a bit crude ("...come on, please"), and it seems to me that his behavior is defensive: he does not follow up the implicit question posed by the patient (What is the mortality risk if I am not operated on?), converting the patient's worry in a reductio ad absurdum ("...how likely a dying patient will die"). Doing so, he is nonetheless answering the patient brutally: "...a dying patient..." is indeed the patient he is talking with, revealing

without much delicacy that he is actually dying because of his pathology. Every human being is a 'being-towards-death' [43], and even though we do not share the philosopher's view, we have to admit it. However, death is not monolithic, and has no doubt numerous forms: 'a dying person' is a tautology; 'a dying patient' is not. The patient is looking for answers outside the surgical option, but the physician does not consider other options at all. Instead, the doctor opts to use his power of knowledge to discard the patient's worries. There is no connection between the clinical world, where the doctor speaks by statistics, and the patient's, where he tries to give voice to his existential anguish. Eventually, the doctor's little regard for the patient's implicit question (What happens if I won't be operated on?) influences the patient's consideration of his own desire to know, reaffirming the reciprocal nature of the doctor-patient interaction. The closing sentence reflects bitterness: the patient changes his direction in favor of irony ("I guess not even Jesus Christ knows that"), saving the doctor's professional profile and giving up his concern.

7. From the Philosophical Discussion to a Practical Analysis

We addressed the problem of "misunderstanding classification" as a text classification task, i.e., the task of assigning a label or class to a given text. At the moment there are no other similar classification tasks. For this reason, we decided to design the system from scratch by starting with a general language model. A solid model for this type of task is XLM-RoBERTa [44]. Its performances are state of the art for different languages and tasks [45]. Furthermore, the pre-trained model (xlm-roberta-base) used is accessible from the Hugging Face [46] model hub.

Our dataset [1] is composed of 32 doctor-patient interviews with a total of 7172 conversational turns (average turns per interview 230). We analyzed them manually, and we annotated 320 instances of misunderstandings, which accounts for 4.4% of the conversational turns. Table 1 shows how misunderstandings are distributed in the dataset. The first two columns contain the name of the misunderstanding and the label we used. The last four columns contain respectively, the total number of misunderstandings of a certain type and if the misunderstanding has been associated with the doctor, the patient, or the caregiver.

Misunderstanding	Label	# Total	# Doctors	# Patients	# Caregivers
Check for understandings	CHECK	199	146	37	16
Clarification	CLA	56	38	15	3
Semantic alternative understandings	SEM ALT	25	13	8	4
Pragmatic alternative understandings	PRAG ALT	20	5	12	3
Lack of understandings	LACK	3	-	1	2
No uptake	NO UP	15	12	3	-
Irrelevance	IRR	2	-	2	-

Table 1
Distribution of the misunderstanding within our dataset.

We analyzed the types of misunderstandings/problematic understandings that occurred during the interviews and found that for doctors most of these instances happened during the

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[1]A request to use the current version of the dataset can be sent to authors' email address.

ACCURACY								
# Epoch	NO UP	IRR	SEM ALT	PRAG ALT	CHECK	CLA	LACK	Average
2	0	-	0	0	1	0	-	0.2
4	0	-	0	0	1	0	-	0.2
6	0	-	0	0	1	0	-	0.2
8	0	-	0	0	1	0	-	0.2

Table 2
Misunderstanding classification without oversampling

ACCURACY								
# Epoch	NO UP	IRR	SEM ALT	PRAG ALT	CHECK	CLA	LACK	Average
2	0	-	0.25	1	0	0.83	-	0.416
4	0	-	0.25	1	0.32	0.67	-	0.448
6	0	-	0.25	1	0.42	0.67	-	0.468
8	0	-	0.25	0.5	0.79	0.5	-	0.408

Table 3
Misunderstanding classification with oversampling

anamnesis. On the other hand, for patients and caregivers, the majority of misunderstandings/problematic understandings occurred during the discussion of future treatment, and some also occurred during the diagnosis.

In order to fine-tune the model and evaluate it the dataset is split at random into 3 parts: training, development, and test with the proportions 80%, 10%, and 10% respectively. Hence, the training dataset is composed of 254 instances, while the development and test set is 32 instances. To allow uniform training, instances composed of more than 50 interactions are reduced to 50. The dataset obtained with this methodology is strongly unbalanced on a single class "CHECK", this is a significant issue for the training data. On the other hand, the unbalance in test data is acceptable since it represents the natural distribution of the phenomenon. Indeed, we noticed during the evaluation that some classes are not present in the test set. A simple solution to this problem is the random oversampling of the underrepresented classes.

The evaluation of the system using the original data is reported in Table 2. Due to the unbalances of the data, the system becomes the trivial classifier that always classifies instances as *CHECK*. This system obtains a high overall accuracy, but evaluated on single class accuracy on average it is slightly better than a random baseline (accuracy 0.17).

Table 3 reports the data obtained oversampling the underrepresented classes. This enlightens the expected behavior of the system. Oversampling allows to classification of small classes, even if showing that with this simple technique, more epochs of training reduce the accuracy of the oversampled classes, probably due to an overfitting of the system. On the other hand, *CHECK* accuracy increases significantly adding more training epochs, this confirms that the system is able to understand the content of the different instances and to better classify this type of misunderstanding.

8. Conclusions

In this work, we introduced the challenge of misunderstanding detection during risk communication dialogues in healthcare. Firstly, we discussed such a challenge from a philosophical perspective. Then, we showed a small, but relevant, use case example demonstrating how state-of-the-art approaches are far from reaching acceptable performance. Indeed, the result confirms the hypothesis that this task is complex enough to deserve further investigation. Future work will focus on several aspects ranging from the acquisition of more data to the design of solutions able to better understand the moments in which the dialogue diverge from its purposes.

Acknowledgments

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