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‘‘All the world’s a stage’’: incongruity humour revisited

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Abstract
Eighteenth and nineteenth century philosophers took interest in humour and, in particular, humorous incongruities. Humour was not necessarily their main interest; however, observations on humour could support their more general philosophical theories. Spontaneous and unintentional humour such as anecdotes, witty remarks and absurd events were the styles of humour that they analysed and made part of their theories. Prepared humour such as verbal jokes were rarely included in their observations, likely dismissed as too vulgar and not requiring intellectual effort. Humour, as analysed by several eighteenth and nineteenth century philosophers, was seen as part of daily life or life simulated on stage. In the twentieth century, Freud emphasized a possible ‘relief’ function of ‘prepared’ humour such as jokes. Additionally, linguists began developing theories to analyse jokes. A joke has a particular structure that is constructed with the aim of achieving a humorous effect. This structure makes jokes suitable for linguistic analysis. In the present-day humour research, jokes have become a main topic of research. This linguistically oriented joke research neglects many other forms of humour: spontaneous humour, non-verbal humour, physical humour, and many forms of unintentional humour that appear in real life. We want to survey and re-evaluate the contributions to the humour research of these eighteenth, nineteenth and early twentieth century philosophers and clarify that their more general contributions to the humour research have been neglected in favour of the very restricted form of prepared humour and linguistically expressed and analysed humour as it appears in jokes. We hope that the views expressed in this paper will help to steer the humour research away from joke research and help to integrate humour in the design of human-computer interfaces and smart environments. That is, rather than considering only verbal jokes, we should aim at generating smart environments that understand, facilitate or create humour that goes beyond jokes.

Keywords Philosophy of humour · Incongruity humour · Humour theories · Human-computer interaction · Human-robot interaction · Computational humour · Smart environments

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1 Introduction

Incongruities can make people laugh. This phenomenon was already observed by early philosophers such as Aristotle in Greece and Cicero in Rome. In the 18th and 19th centuries in particular, English, Scottish and German philosophers attempted to describe humour and give it a place in their more general explanations of human behavior. In developing their theories, they rarely included jokes in their illustrations of humour. Joke collections existed; in fact, the earliest collection of jokes dates from the 4th or 5th century, and other collections are from the Middle Ages, the 17th century and later. Not only were the jokes vulgar, but book scholars and their intellectual activities were ridiculed in these jokes. It is quite understandable that such humour did not actually become part of the 18th and 19th century philosophical reflections on humour. Rather, these philosophers considered wit and absurdness in real-life situations, that is, spontaneous and unintentional humour that requires some intellectual effort to create or understand. In later years, Sigmund Freud focused on jokes and assigned positive functions to sexual and aggressive jokes (the release of tension) in his theory of the 'unconsciousness'. Joke analysis also became the main topic of the humour research in the 20th century because linguistic theories and computational linguistic tools became available to analyse and give meaning to sentences, dialogues, and short texts.

Although in the current humour research it is not unusual to offer obligatory remarks on the early explorations into incongruity humour of the 18th and 19th century philosophers [1, 2], we note that these philosophers' observations have not fully been exploited, especially given our interest in considering forms other than 'prepared' humour. Jokes, as they appear in joke books or as used by humour researchers, are 'prepared humour,' and telling or listening to such jokes is not truly part of our daily activities. Despite this, we smile and laugh a lot during our daily activities; thus, we can conclude that such smiles and laughter are invoked in other ways.

Hence, this paper is an investigation into what we can learn from the 17th, 18th, 19th and early 20th century philosophers who did not focus on jokes as the most important expression of humour. Rather, they studied spontaneous and unintentional forms of humour and often did so from the perspective of incongruities and their resolution. One reason to focus on these types of human humour is human-computer interaction research. In this research we must consider situations in which communication with a computer not only occurs through a speech and natural language processing interface but also with a smart environment, a robot, or a virtual agent that is expected to be aware of events in its environment and to understand such events. The understanding of events by smart technology should also allow for the possibility of its commenting on such events in a humorous way or providing the user with a possibly humorous view on events. The latter would also allow the user to humorously comment on such events while interacting with the other inhabitants of a smart environment. Non-humorous events can nevertheless give rise to humorous comments that provide an unexpected view of the event. Facilitating the creation of humorous events or having the environment or its virtual and autonomous agents create such events is a next step. Sensors and actuators in a smart environment can be reconfigured to (help to) produce a humorous event; or, when the smart environment has an 'artificial' sense of humour, it can decide to produce humour while interacting with a human partner or partners.

Humour has become a topic of interest in the research on human-computer interaction [3]. Humour, whether it occurs unintentionally or is introduced intentionally, has interactional, educational, and social benefits in human-human interaction. Hence, when a human in human-human interaction is replaced by a computer application, and the human tasks are taken over by such a computer application, we can nevertheless ask how we can retain these

benefits. Perhaps we can even strengthen such benefits by using our knowledge about the role that humour can play and introduce that knowledge in the algorithms that control the interface (whether it is a menu-based graphical user interface, a textual natural-language interface, an embodied chatbot or virtual agent, a humanoid robot, or some other physical object with which we feel comfortable to interact in a human-like way).

How often do people tell jokes? Joke-telling is an unusual act in daily human-human interaction. Unfortunately, the present-day humour research is focused on the analysis of jokes. There is quite a difference between the telling of a canned joke, presenting a cartoon or animation, and being able to detect and understand that something funny is happening in the real world or making something funny happen in the real world. Jokes are usually artificially constructed short stories that are meant to mislead the listener. The set-up allows multiple interpretations until a punchline is introduced that forces the listener to reinterpret an initial, usual stereotypical, interpretation of the story to an interpretation that very much opposes the original interpretation without the need for changing the narrative and its main characters. Although the existence of jokes can be traced back to several centuries BC, humour philosophers in later centuries did not truly take jokes into account in their philosophical investigations. When philosophers made their first observations on humour and in particular what makes people laugh, they did not take into account canned humour or lower-class 'toilet' humour. Rather, as will be shown in this paper, they analysed spontaneous and unintentional humour and often focused on the intellectual effort required to produce such humour, for example, the building of a humorous argument.

Human-computer interaction researchers who aim at the use of humour in natural, human-like interaction with a smart computing device are not that interested in scripted humour or scripted joke performances. That is, they are aiming for humour that is created spontaneously, in the spirit of the moment, making use of the elements offered by the context in which interacting participants perform. Additionally, they are interested in non-linguistic humour that appears or is generated unintentionally. This latter type of humour appears, for example, because of absent-mindedness, because of stupidity, or nonfamiliarity with new situations (for example, unfamiliar technology). Humour can appear because we give a humorous interpretation to an event, regardless of whether it is related to a (conversational) interaction with a partner. In that case, we cannot truly identify the difference between spontaneous and unintentional humour. Further, as mentioned above, smart technology such as sensors and actuators integrated in a physical environment and in the Internet of Things offer possibilities for smart humour.

In the following sections, we discuss observations on incongruity humour as they were made by early philosophers and psychologists until the twenty-first century. In the next short section, we set the stage with a few global observations on what we consider today to be incongruity humour to facilitate our interpretation of earlier observations. The current view is coloured by the literature on joke analysis, that is, on the linguistic mechanisms that underlie jokes. In considering humour as it appears (accidentally, unintentionally, spontaneously, and planned) in forms other than in jokes, the linguistic incongruity view does not always seem to cover these various other forms. The incongruities are there; however, they sometimes escape the type of analysis that can be used for jokes, let alone that such analysis can provide satisfactory insight into how incongruity humour can be created in physical environments and digitally enhanced physical environments. This is the main reason why we think it is useful to return to views on wit and humour developed by 17th, 18th, 19th, and 20th century philosophers. They were not interested in prepared humour as it appears in jokes, but, rather, they considered wit and other forms of humour as they appeared in real life or, in an exaggerated form, on stage. Obviously, they did not know about smart

technologies; however, more importantly, they did not assume that jokes where the most important expression of humour. On the contrary, there was the assumption that jokes belonged to the lower classes of society, and they were not worthy of philosophical and intellectual investigation into humour. We will focus on such views in Sections 3 to 5.

Our hypothesis is that the early, non-joke-oriented investigations into humour can inspire future approaches to non-verbal humour that are more general and perhaps more successful than the current, linguistically motivated approaches. Before doing so, in Section 6, we are compelled to explain why jokes have received so much attention in the humour research. Further, we aim to address how the humour research, at least that which has aimed to model humour rather than investigating the uses and effects of humour, with a focus on the linguistic mechanisms of jokes, has neglected humour as it occurs in our daily life activities and interactions. In this section, we consider the 'information processing' view on the modelling of humour followed by the computational point of view of humour. In this section, we also mention some attempts to computationally generate humour. Section 7 addresses humour as it has been discussed in non-linguistic contexts. We reflect upon the earlier approaches to humour by essayists, philosophers, and psychologists, as discussed above. In Section 8, we shortly address humour in smart environments. What is the role of sensors and actuators in perceiving and generating humorous incongruities? Can we create smart environments that are humour-aware or that have a sense of humour that can be put to use? Discussion and conclusions follow in Section 9.

2 Incongruity humour

In the traditional humour research, usually three viewpoints are distinguished. They are complementary rather than distinct. The distinction is between a cognitive, psychological and functional point of view. Underlying these approaches is the observation that humour requires a safe and playful context. This latter observation is noted in many papers including [4, 5]. Critchley [6, p.4] states that there must be some 'social congruity' between speaker and listeners before a joke can be appreciated. Participants must share a 'paratelic', non-goal-oriented psychological state. The situation must be non-threatening for someone listening to a joke or an observer of a humorous event in order to experience amusement.

Apart from this non-goal-oriented psychological state, humour researchers distinguish between an 'incongruity' approach, a 'relief' approach and a 'superiority' approach to humour. In this section we only focus on the incongruity approach. All three approaches will become part again of future sections in this paper.

Incongruities can be expressed in language and can become part of verbal interactions. They can also occur in events and situations that we perceive in the real world. Moreover, the incongruity approach addresses perceived incongruities; actual incongruities are not a prerequisite of such humour. Moreover, there can be an incongruity between what we observe and what we think or imagine. Unfortunately, the focus of the humour research has been on jokes and other forms of linguistic humour, neglecting such other, admittedly more complicated, forms of humour.

The incongruity point of view is about the cognitive shift that we must make to recognize that a particular utterance in a conversation, a description of a situation or event, or something in the physical environment, causes us to change our stereotypical interpretation of what is described. It should involve an interpretation that is not simply slightly different but rather opposes our initial interpretation of the event or its description. In a joke, it is usually the punch line that makes us aware that our initial interpretation of what we've

been told was wrong. The punchline introduces an incongruity; and becoming aware of this incongruity, and 'resolving' it, is an experience that leads to amusement or even laughter.

Various attempts have been made to provide a more formal description of this incongruity view of humour. A formal description would allow an algorithmic description, that is, a sequence of rules that computes whether a particular input (a sequence of utterances, a description of an event, or an event that is perceived in a multisensorial way) should be considered humorous. In a joke or a conversation, we have a sequence of utterances, and there is a punchline or remark that provides a completely different view on what has been thus far presented. The humour research usually focuses on the psychological aspects of humour. An exception is the research on verbal humour, in particular, the analysis of jokes or the generation of puns. These research attempts draw heavily on computational linguistics, although in previous years machine learning methods have also been applied to recognize humorous utterances on the web, that is, to distinguish between humorous and non-humorous utterances.

In addition to the incongruity perspective, humour researchers have introduced a 'relief'- and a 'superiority' point of view. These views complement the cognitive viewpoint expressed in the incongruity approach with views on the functional aspects of humour (the superiority point of view) and the psychological effect of humour (the relief point of view). In later sections where the main focus is on how the incongruity concept appears in the historical literature on humour, we will return to these viewpoints in order to contrast them with the incongruity perspective.

During the late 20th and recent 21st centuries, the humorous incongruity concept has been studied from the perspective of joke analysis. We are more interested in humour that can occur in physical environments or digitally enhanced physical environments and conversations, that is, environments where humanoid and social robots perform in interaction with human partners. While the more recent observations on humorous incongruities presuppose verbal humour, the 17th to 20th century observations were more general. The Chomskyan revolution in linguistics starting in the 1950s and later interest in artificial intelligence led to attempts to design formal models for language and made it attractive to engage in humour research in the context of these developing research areas. The earlier observations on humorous incongruities are less language-oriented and often include observations on humorous events that happen in the real world and are considered to be humorous (mostly for observers), or events that have been designed for comedies on stage.

Following William Shakespeare's "All the world's a stage, And all the men and women merely players.", we think that smart technology allows us to consider the digitally enhanced physical world in which we will live as a smart stage that can be exploited to facilitate and initiate humorous events. The main aim of this paper is to clarify that there have been many observations on humour that do not address jokes or other forms of linguistic humour. Further, the paper posits that these observations offer useful approaches, ideas, and stimuli to change the focus of the current humour research from joke analysis to include the many other types of humour we encounter in our daily lives.

3 Eighteenth century British philosophers on incongruity humour

In the seventeenth century, England, Germany, the Netherlands and other European countries produced jest-books, collections of humorous tales and anecdotes, sometimes in the form of narratives with a punchline. They must have been enjoyed by the 17th century middle- and high classes (who could afford to buy them). Philosophers who took the

laughter, the ludicrous and the ridicule seriously and belonged to the 'high culture' built theories on wit and absurd reasoning, which require intellectual effort, rather than vulgar sexual and scatological jokes. Earlier observations on humour focused on what makes people laugh in real life, rather than on listening to prepared humour as it appears in jokes. For that reason, we think it is useful to provide the views on humour of certain 18th, 19th and early 20th century philosophers who focused on humour, in particular, humour (ludicrous, ridicule-oriented) in general, that is, in real-life situations, rather than as it appears in jokes or word humour.

In bringing forward these approaches, we endorse the views of John Morreall's [7] statement, "Enough with the Jokes" and his case for research into spontaneous humour rather than into prepared fictional humour that we encounter in jokes. In the next sections, we also distinguish between intentional and unintentional humour in accordance with some of our previous publications [8, 9], in which we have mentioned 'accidental' humour.

Although references have been made to Aristotle and Cicero, the main inspiration for the later British philosophers is probably Thomas Hobbes (1588–1679) who in 1640 defined laughter as a "sudden glory arising from some sudden conception of some eminency in ourselves, by comparison with the infirmity of others, or with our own formerly" [10]. Hobbes is not positive about this cause of laughter. It is vain glory to think the infirmity of another sufficient matter for this glory. In his book, Leviathan (1651) [11], he adds the following critical comment: "And it is incident most to them, that are conscious of the fewest abilities in themselves; who are forced to keep themselves in their own favour, by observing the imperfections of other men." Hobbes' view has become known as the superiority point of view of humour.

There is a much older view that sometimes still emerges in observations on humour. In the original meaning from Greek medicine, 'humours' were the bodily fluids that affect a human's health. They were black and yellow bile, phlegm, and blood. There had to be a proportional balance among them. There were also four corresponding temperaments that were caused by an imbalance: melancholic (excess of black bile), choleric (excess of yellow bile), phlegmatic (excess of phlegm), and sanguine (excess of blood). An example of this is found in a 1695 essay by William Congreve (1670–1729) [12]. Congreve discussed 'Humour in Comedy', in which 'humour' is indeed a personality characteristic. Congreve was a successful comedy writer. Various 'Characters of Humour' can appear in a comedy, and they will have different behaviours on stage. For example, a choleric person or 'Character of Peevish Humour' will have a more satirical use of wit, while a 'Character of Sanguine Humour' will have a more careless and facetious wit. Perhaps today we should say that someone has different 'senses' of humour. In his comedies, for example, 'Every Man in his Humour' Congreve satirized the manners of English society. Thus, Congreve made references to Greek humourism and medieval medicine; however, we see it tuned to a context of comedy, comic situations, wit, and laughter. In later 18th century essays on wit, ridicule and the comic, a 'humorous' person or a 'Character of Humour' was one who was receptive to the comic and the ludicrous and was able to depict it. In addition, the word 'humour' was used in a general sense to denote the object of mirth, such as odd behavior, jokes, raillery and facetious remarks. Nevertheless, we see the word used in different papers with different meanings. References to the Greek 'humours' remained in vogue until late in the 18th century.

In his 1709 "Essay on the Freedom of Wit And Humour", published in 1737 [13], Anthony Ashley Cooper, the Third Earl of Shaftesbury (1671–1713) also considers 'Humour' to be a quality of character. He makes many metaphorical references such as 'to temper and regulate Humour', ill 'Humour' (that can be the cause of Atheism), sour

'Humour' and bitter 'Humour'. However, the essay is in defence of raillery, a species of wit that, according to Shaftesbury, includes drollery, mimicry, buffoonery, burlesque, banter, and irony. He argues that a distinction can be made between Good Humour and Ill Humour, that there is 'true' raillery and 'mannerly' wit and that a sober use of raillery is recommended. He further states that the lowest and most scurrilous modes of wit are not to be used by a man of 'good-breeding'. In Shaftesbury's essay, 'mannerly' wit is given a positive role in criticizing society and religion; Humour was a 'test of truth' and a tool for reason. Shaftesbury did not elaborate on the specific content of wit or humour. Hence, as opposed to statements by Amir [14], there is no explicit mention of incongruities in Shaftesbury's work nor is there a superiority perspective as advocated by Thomas Hobbes.

A distinction between 'good' and 'false' humour is also made by Joseph Addison (1672–1719) in 1711 [15]. He co-founded the *Spectator* journal in 1711. The publication was meant "to enliven morality with wit and to temper wit with morality". In his 1711 contribution, Addison demonstrated his contempt for so-called false humour such as apish tricks, buffooneries, mimicry, and mock-representation, as well as someone who " ... pursues no point either of morality or instruction, but is ludicrous only for the sake of being so." Addison's 1712 essay "Pleasures of the Imagination" in the *Spectator* [16] addresses beauty and aesthetics. While types of comedy are mentioned in Addison's and in many preceding essays, the question of which characteristics should be satisfied for an object or circumstances to guarantee laughter is not truly answered.

Addison's "Pleasure of the Imagination" was the inspiration for Francis Hutcheson (1694–1746) who introduced an incongruity perspective of the causes of laughter in 1725 [17] and Mark Akenside (1721–1770) [18] who wrote a long poem in 1744 in which also the incongruity perspective appears. Hutcheson's letters to a journal as well as Akenside's poem and accompanying comments are more explicit about the conditions that allow laughter to emerge. Francis Hutcheson wrote his letters (essays) about laughter to the *Dublin Journal*. These essays are collected in [17]. In his first essay, he attacks Hobbes and his views on laughter: "But Mr. Hobbes, who very much owes his character of a Philosopher to his assuming positive solemn airs, which he uses most when he is going to assert some palpable absurdity, or some ill-natured nonsense ... " Then, further ridiculing Hobbes and giving counterexamples, Hutcheson argues that there are many occasions where we laugh without necessarily having a corresponding feeling of superiority and that not every feeling of superiority necessarily causes laughter. In his second essay letter, Hutcheson presents his own views on the causes of laughter. He is inspired by writings of Addison [16] who discussed the use of metaphors to strengthen an idea. The use of a metaphor provides an additional view that helps in clarifying an idea's validity. Hutcheson proposes the introduction of an additional view that contrasts with the original view. Although there must be some resemblance between the original and the added view, the added view is unexpected. This leads to the following observation: "That then which seems generally the cause of laughter is the bringing together of images which have contrary additional ideas, as well as some resemblance in the principal idea: this contrast between ideas of grandeur, dignity, sanctity, perfection, and ideas of meanness, baseness, profanity, seems to be the very spirit of burlesque; and the greatest part of our raillery and jest is founded upon it."

Here, we have the essence of incongruity humour theory, including the observation that to achieve humour (or, in Hutcheson's case, laughter), it seems that the second view does not simply provides contrast but also introduces a view that reduces our respect for the actors and the circumstances. Observing particular behaviours or circumstances and commenting on them can make them laughable. Hence, Hutcheson's views on laughter are not at all restricted to verbal humour. He nevertheless mentions puns, for which the resemblance is

not in ideas but in sounds. In a third essay, he further illustrates his views on laughter with examples, also providing observations on the social aspects related to the proper and improper use of jests and ridicule to invoke laughter.

In Hutcheson's writings, the words 'incongruity' or 'incongruous' do not appear; nevertheless, we can say that his wordings can be considered to be an initial description of what later comes to be called the incongruity view of humour. We should emphasize that the incongruity point of view introduced by Hutcheson aims at characterizing the qualities of objects, ideas and circumstances that may evoke laughter. Through this perspective, resemblance and contrast are emphasized and this provides insight into laughter-evoking objects (including ideas, thoughts, behavior, events, and circumstances) in general and their positive and negative associations in particular contexts. This incongruity view focuses on content rather than form (banter, buffoonery, raillery, burlesque, ridicule, and wit).

Addison's 1712 "Pleasures of the Imagination" also received attention from the above-mentioned physician and poet Mark Akenside. He published a 'didactic' poem on "The Pleasures of Imagination" in 1744 [18]. In this poem Akenside treats the pleasures of the Sublime, the Wonderful, and the Beautiful, exemplifying them with many examples. In the last part of the poem, he discusses the pleasures of ridicule. Akenside pursues a 'scientific' approach: "Notwithstanding the general influence of ridicule on private and civil life, as well as on learning and the sciences, it has been almost constantly neglected or misrepresented, by divines especially. The manner of treating these subjects in the science of human nature, should be precisely the same as in natural philosophy; from particular facts to investigate the stated order in which they appear, and then apply the general law, thus discovered, to the explication of other appearances and the improvement of useful arts." In the poem and especially in its accompanying notes different types of ridicule and incongruity are treated. In Akenside's observations " ... incongruous properties may either exist in the objects themselves, or in the apprehension of the person to whom they relate" and " ... inconsistent properties must belong to the same order or class of being" or about physical objects that are incongruous in their environment, we can recognize the present-day views on incongruity humour. Akenside also mentions that to contemplate the ridiculous, the mind should be at leisure, and there should be no feelings of terror, pity or indignation.

During this period, various confusing and contradictory terms related to the objects of laughter (wit, ridicule, banter, humour, raillery, absurdness, buffoonery, and burlesque) were introduced. Poet and playwright William Whitehead (1715–1785) wrote in 1743 a verse "An Essay on Ridicule" [19], addressing various aspects of ridicule (test of truth, satire, objects of ridicule). In the same year as Akenside, Corbyn Morris (1727–1809) published "Essay Towards Fixing the True Standards of Wit, Humour, Raillery, Satire, and Ridicule" [20]. One of his aims was to distinguish wit from 'humour.' Wit was assumed to be grave, dry, artificial, and interesting for the educated elite ('men of wit and learning'), while 'humour' was seen to be more natural and benign. Morris mentions that others (Cowley, Barrow, Dryden, Locke, Congreve, and Addison) had tried in the past to define wit (and humour, raillery, satire, and ridicule). He discusses their attempts but concludes that all have left the definition free and unconquered. An example of his definitions is the one for wit: "WIT is the LUSTRE resulting from the quick ELUCIDATION of one Subject, by a just and unexpected ARRANGEMENT of it with another Subject." Here, we can see an attempt to decompose wit in elements, similar to Hutcheson's approach and an indication of humorous incongruity. Morris explains that there must be a connection between the subjects and that they are related, even in contrasting relationships. Interestingly, Morris adds " ... there may be wit in a picture, landscape, or in any prospect, where a gay unexpected assemblage of similar, or opposite objects, is presented." A similar definition is given to 'ridicule': "... any

Motly Composition, wherein a real or affected Excellence and Defect both jointly appear, glaring together, and mocking each other, in the same Subject." We can contrast this with Morris' definition of humour, which employs as its only subject persons and their whimsical oddities and foibles of temperament and conduct.

According to Morris, it is universally felt and established that 'humour' gives more delight than wit: "HUMOUR is Nature, ..., WIT only a Stroke of Art." However, Morris also asserts that humour and wit can be united. Morris does not mention 'incongruity'; however, his definitions of wit and ridicule coincide with the present-day idea of incongruity. In his 'Essay on the Ridicule' of 1753 [21], Scottish painter and poet Allan Ramsay (1713–1784) distinguishes two types of ridicule: a simple, direct and unreflected type that refers to improper manners and actions, and a more sophisticated, argumentative type. He criticizes Shaftesbury and others for their loose interpretation of ridicule and for jumbling together raillery, burlesque and ridicule. In his view, ridicule is a branch of eloquence and should be used to persuade and convince and at the same time excite laughter in listeners.

In 1764, the Scottish philosopher James Beattie (1735–1803) provided a more detailed incongruity point of view on humour than that of Akenside. He discussed humour related to feelings of superiority, humour experienced by incongruities and, to a lesser extent, an associated 'pleasing' emotional state to which he referred as 'risible emotion' [22]. Beattie writes that humorous laughter arises from "two or more inconsistent, unsuitable, or incongruous parts or circumstances, considered as united in one complex object or assemblage, as acquiring a sort of mutual relation from the peculiar manner in which the mind takes notice of them". His characterization of humorous incongruity is not very different from how we see it today: "Laughter seems to arise from the view of things incongruous united in the same assemblage: I. By Juxta-position; II. As Cause and Effect; III. By Comparison founded on Similitude; or, IV. United to exhibit an opposition of Meanness and Dignity."

With Beattie's observations, it becomes clear that, using today's terminology, he assumes the exertion of cognitive effort in apprehending humour. His view on 'risible emotion' indicates that we are conscious of this cognitive effort. From observation IV (and its explanation in Beattie's essay), we can conclude that his views on incongruity also include the feeling of superiority that can often be associated with experiencing humour or 'risible emotion'. Beattie investigates the conditions under which incongruities are humorous and when they are not humorous. Many examples of different types of humorous incongruities are presented. He emphasizes the opposition that must be present when there are alternative views on a particular object (situation, event, appearance, behavior). Examples include the opposition between dignity and meanness, between likeness and dissimilitude and, more generally, between suitableness and unsuitableness. The stronger this opposition is, the more humorous the incongruity is. Another important observation of Beattie's is that to discuss a degree of incongruity, we must be able to compare alternative views, which is not possible with a juxtaposition of events that are not related and that cannot be compared. Beattie spends a chapter on the limitations of his view on humorous incongruities, that is, when incongruities are not 'ludicrous'. The essay addresses issues such as 'moral disapprobation' and emotions that are triggered by a potentially humorous event, for example, pity or fear, and that prevent the experience of a 'risible emotion' or an 'amusement emotion'. A certain amount of emotional, subject-dependent, distance is necessary to appreciate an incongruity as humorous.

Of interest is William Preston's "Essay on Ridicule, Wit and Humour" (1788) [23]. Unfortunately, only part of the essay on ridicule seems to have been published. William Preston (1753–1807), poet and member of the Royal Irish Academy, does not use the word 'ridicule' in the sense advocated by Ramsay. Rather, he uses it to denote everything that

"excites the emotion of *mirth*." He mentions "defects and blemishes of the lighter kind" in subjects; however, he emphasizes that instead of mirth there is pity or a sense of inconvenience when we realize that it concerns the health and well-being of a person. He also mentions that mirth should not be confounded with laughter, as was done by Hutcheson. Preston follows Hobbes but replaces 'laughter' with 'mirth': "mirth arises from the sudden conception of some eminency in ourselves, by comparison with our infirmity formerly, or that of others." There is a degradation of the object of mirth. However, as with Hutcheson (and Akenside, and Beattie), Preston also wants to assert what constitutes the object of mirth rather than simply identifying its effect, that is, the conception of eminency in ourselves, our feeling of superiority. Hence, in global terms, there must " ... be some competition, as well as inferiority; a resemblance and a contrast in the objects compared."

Unlike others, Preston elaborates this 'incongruity' point of view. That is, he presents four classes of objects that lead to mirth: caricatures of human actions, corporeal blemishes and defects, unforeseen disasters and mischances, and, most importantly, incongruities. He continues by distinguishing four categories of incongruities. The first is incongruity between one's words, actions or sentiments and one's physical situation. The second is incongruity between one's manner of speaking, acting and thinking and one's civil or political situation. The third is the result of cultural differences between people. The fourth follows from disparity between passions and their objects, i.e., the disproportion between means and their ends.

In the history of incongruity humour, Preston's rendering incongruities concrete by categorizing, describing, and illustrating them makes his contribution unique. Other attempts to categorize (humorous) incongruities appear only two hundred years later. Preston's approach also gives rise to a view whereby Hobbes' contrasting juxtaposition of the inferior and the superior can be seen in itself as an incongruity.

Preston's honouring of Hobbes may not have been appreciated by others. Neither were his remarks about 'humours'. In his essay, he still mentions "the due secretions of the humours", the "afflux of humours", and the "evacuation of humours in the form of tears." Preston was criticized because it was said that he was imposing meaningless changes on words, vox et praetera nihil (sound without substance).

Eighteenth century scholars, painters, poets, and other essay writers wrote about jests, buffoonery, comedy, the comic, the ludicrous, ridicule, wit, banter, jokes, raillery, satire, irony, humour, and other words that were likely used to describe that which induces mirth and laughter. As of 1716, Richard Blackmore [24] mentioned that " ... many ingenious Persons, by their unsuccessful Essays to explain it, have rather obscur'd than illustrated its Idea." A comprehensive discussion of the introduction and the evolution of the use of such words and their changing meaning during the 17th to 19th centuries can be found in Wickberg [25]. The definitions of 'wit' and 'ridicule' were generally assumed to require more clever ways of observing and reasoning than 'vulgar' humour. Therefore, they also received more serious intellectual attention. As mentioned in 1759 by Goldsmith [26, p.155], "The truth is, the critic generally mistakes humour for wit, which is a very different excellence. Wit raises human nature above its level; humour acts a contrary part, and equally depresses it. To expect exalted humour, is a contradiction in terms ..."

Blackmore [24] warned against the dangers of using wit. It should not be employed in writings in which understanding must be expressed in a clear and strong manner that, "... they admitted, would appear *incongruous* and impertinent ..." Wit should not be used to disgrace religion, allow obscene discourses or ridicule defects and deformities of the body and mind. In short, "Men of singular Wit, like Women of great Beauty, should never be unguarded." Nevertheless, wit and ridicule were employed by British deists to ridiculize

biblical miracles. While some characterized this age as the 'age of reason', in [27] it is mentioned that " ... the age of reason could perhaps more eloquently and adequately be called the age of ridicule ... "

4 Entering the nineteenth century: incongruity in wit, absurdness, and humour

In the section above, we describe the emergence of the consciousness of incongruity humour in the eighteenth century. In the seventeenth century, Hobson introduced the inferiority-superiority view. It did not provide us with a view on that which constitutes humour. Then, in the eighteenth century, there were many attempts to characterize styles of humour, which included banter, horseplay, buffoonery, raillery, bulls, satire, irony, puns, quips, jests, wit and ridicule. Moreover, there is 'good', 'false', and 'ill' humour, and there is laughter and mirth. These styles and causes of humour do not always assume that their content should be expressed verbally. Incongruities can be perceived in the physical world, and they do not necessarily require verbal expression. Incongruities can be perceived in the physical world, where they can be commented upon and imagined by contrasting what had been perceived in prior individual experiences or through common sense knowledge that guides expectations on how things (objects, behavior, events) ought to appear.

Rather than distinguishing the various styles of humour, British authors focused on 'wit' and 'humour'. In this section, we have provided a few more observations on 'wit' and 'humour' as discussed by early nineteenth century British essayists. We can observe that 'humour' slowly became an umbrella term, 'humour' and 'wit' became overlapping terms, or 'wit' was treated as a subcategory of 'humour'.[1]

4.1 Sydney Smith, Leigh Hunt, and William Hazlitt on incongruity humour

We mention three more British writers on humour that published in the nineteenth century: Sydney Smith (1771–1845), Leigh Hunt (1784–1859), and William Hazlitt (1778–1830). Smith [29] lectured on wit and humour. In his lectures, he mentions that the object of laughter is always inferior to us; however, the converse is not true. In that way, Smith distinguishes himself from Hobbes. More concretely, Smith wrote as follows: "This discriminating cause is incongruity, or the conjunction of objects and circumstances not usually combined." Smith distinguishes 'wit' from 'humour'. For Smith, the latter is more about manners, appearances, absurd situations, and anecdotes. Buffoonery is about voluntary incongruity and incongruity of the body. Puns are not appreciated: "I have very little to say about puns; they are in very bad repute and so they ought to be. The wit of language is so miserably inferior to the wit of ideas, that it is very deservedly driven out of good company." Smith has a more original and optimistic view on the dangers of wit than his predecessors: "wit is dangerous, eloquence is dangerous, a talent for observation is dangerous, ... , nothing is safe but mediocrity."

Smith can be distinguished from earlier humour writers because he lectured on humour. Leigh Hunt can be distinguished from earlier writers because he aimed at presenting a

[1] At present (2018), after two more ages of humour research, it is useful to again distinguish among humour styles and explore their characteristics. In [28] the characteristics of sarcasm, cynicism, satire, irony, fun, humor, nonsense and wit are distinguished and discussed in a 21st century context.

survey of wit and humour as they appeared in the work of English poets [30]. Hunt, in 1846, asserts that there is still a distinction between 'wit' and 'humour': "Wit may be defined to be the Arbitrary Juxtaposition of Dissimilar Ideas, for some lively purpose of Assimilation or Contrast, generally of both." Hunt contributes to the humour research by distinguishing fourteen forms of wit that range from similes and puns to moral and intellectual incongruities. Again, 'wit' is about ideas, and 'humour' is related to incongruities related to the body, character, and circumstances.

In his "Lectures on the English Comic Writers" [31], Hazlitt distinguished 'wit' and 'humour'. Hazlitt's lectures were held in 1818. Hazlitt's views were not different from those of Smith: "The essence of the laughable then is the incongruous, the disconnecting one idea from another, or the jostling of one feeling against another." 'Humour' versus 'wit' was described by Hazlitt as follows: "Humour is the describing the ludicrous as it is in itself; wit is the exposing it, by comparing or contrasting it with something else. Humour is, as it were, the growth of nature and accident; wit is the product of art and fancy. Humour, as it is shewn in books, is an imitation of the natural or acquired absurdities of mankind, or of the ludicrous in accident, situation, and character; wit is the illustrating and heightening the sense of that absurdity by some sudden and unexpected likeness or opposition of one thing to another, which sets off the quality we laugh at or despise in a still more contemptible or striking point of view ... " Hazlitt mentions the role of the comic to relax the stress of our daily responsibilities. He further emphasizes the superiority that we feel when seeing and laughing about the misfortune of others.

4.2 Immanuel Kant, Arthur Schopenhauer and Søren Kierkegaard on incongruity humour

Unlike what we often see mentioned in the humour literature (see for example Morreall [1]). Immanuel Kant (1724–1804) did not really play a role in the further development of the incongruity perspective of humour. He observed the following: "Laughter is an affect arising from the sudden transformation of a strained expectation into nothing" [32, p.209]. However, this observation hardly received further explanation, while British philosophers and essay writers, from Hutcheson to Beattie and Preston, had already provided extensive views on humorous incongruities and even on the structure of incongruities [22] and categories of incongruities [23]. Obviously, Kant's 'transformation into nothing' can be viewed as the ultimate degradation or diminishment of an initial interpretation of an object of laughter to nothing.

Some additional global observations on the causes of laughter can be found in Kant's writings; however, again, there is nothing new in his observations. For example, he writes that "a joke must always contain something that can deceive for a moment" [32, p.210]. He also notes that laughter " ... arises out of the sudden but harmless reversal of expectation" and that it " ... occurs when all of a sudden one sees oneself faced with the opposite of what expected." Kant also mentions rapidly shifting ideas in the mind and transpositions of standpoints. Kant provides warnings: "Absurdities must not underlie the laughter, but rather something reasonable." One should not laugh about someone falling, anything vulgar, or practical jokes that are harmful to others. Additionally, laughing when alone is not allowed [32, p.452]. In Kant [33, p.347], there is a reference to 'Ungereimtheiten' that perhaps comes closest to 'incongruities' (inconsistencies or absurdities). However, apart from some examples, that which constitutes incongruities or perceived incongruities is not discussed. In his discussion of aesthetics, Kant distinguishes between agreeable and beautiful art; thus,

'beautiful' refers to cognition and 'agreeable' to 'sensations' such as the enjoyment that comes from 'humour'.

Arthur Schopenhauer (1788–1860) presents very elaborate views on incongruities. His theory of the ludicrous adds to Beattie's views on incongruity. Schopenhauer's well-known remark on the cause of laughter in "Die Welt als Wille und Vorstellung" (published in 1818/19 [34, 35] is as follows: "The cause of laughter in every case is simply the sudden perception of the incongruity between a concept and the real objects which have been thought through it in some relation, and laughter itself is just the expression of this incongruity." Schopenhauer states that his theory is so simple and comprehensible that it does not require examples. However, on a more abstract level, he is willing to share the confirmation of his theory and illustrate it by distinguishing two categories into which the ludicrous (the cause of laughter) can be divided. In addition, he is also willing to illustrate these two categories with examples: "Yet, in order to come to the assistance of the mental inertness of those readers who prefer always to remain in a passive condition, I will accommodate myself to them."

The two categories distinguished by Schopenhauer are wit and folly. They can be seen as classes of intentionally created and unintentionally appearing causes of laughter and joy. In the case of wit, we pass from the real, i.e., the perceptible, to conception. That is, "two or more real objects are thought through one concept, and the identity of the concept is transferred to the objects; it then becomes strikingly apparent from the entire difference of the objects in other respects, that the concept was only applicable to them from a one-sided point of view."

Schopenhauer illustrates this process with an anecdote about a Gascon (inhabitant of the French region Gascony; its inhabitants were well-known for their wit and boasting skills) who was laughed at by the king when he saw the Gascon in light summer clothing in midwinter and not trembling at all. When asked how that was possible, the Gascon answered that the king would find it very warm too if he, similar to him, had also put on his whole wardrobe. Two wardrobes are the 'real objects,' and the conception 'the whole wardrobe' is not truly applicable for defying the cold with light summer clothing. However, that is where the boasting comes in.

It is perhaps unnecessary to mention that the 'real objects' in these observations are not necessarily physical objects. Anything that can be perceived by or sensed can be subsumed as object. Other examples of wit are mentioned by Schopenhauer. He is certainly interested in wit in real life situations. Additionally, with some effort, anecdotes such as the one about the Gascon in his light summer clothing can be transformed to present-day structured jokes with a narrative consisting of a set-up and a punch line. Other examples of intentionally created causes of laughter that are mentioned are about the use of irony, equivocation, and verbal wit (word play). Obviously, some of this language use can also appear unintentionally. In jokes, there is an intentional introduction of discrepancies between conceptions and reality. However, Schopenhauer is only interested in them if they are concealed behind seriousness (irony) or when seriousness is concealed behind them (which he calls humour). Hence, jokes containing vulgarities, insults and sexual innuendos should, in Schopenhauer's sophisticated views and opinion, not be considered humour.

The second category of the ludicrous that is mentioned by Schopenhauer is absurdness and foolish actions (folly). Here, the idea is that we pass from conception to the real or perceptible things that are thought through it. In Schopenhauer's words, "It occurs just as often, however, that the incongruity between a single real object and the concept under which, from one point of view, it has rightly been subsumed, is suddenly felt."

That is, we begin with a concept that is present in our knowledge, we pass from it to reality and are then confronted with a situation, an event or a reasoning that is different from what is expected. Schopenhauer notes that this category of the ludicrous is essential to comedy. One of his examples is about the absurdness caused by reasoning with premises that appear to be similar but that, nonetheless, when combined, contradict each other. This is the well-known walking alone-together story, which goes as follows: "Someone declared that he loved walking alone. An Austrian then said 'You like walking alone; so do I: therefore, we can go together."' Notice that in this example the Austrian is supposed not to realize that his remark is absurd. The Austrian's concept is that when two people enjoy the same thing, then they can enjoy it together. Another example provided by Schopenhauer is the story of guards who invite a prisoner for a card game and then send him away from prison because he is cheating. Other examples to illustrate his view are the many foolish actions in Miquel de Cervantes' Don Quixote (1615) and the absurd actions of Baron Munchausen that are portrayed in a book by Rudolf Erich Raspe (1785). We may also laugh when we see human characteristics in the behavior of animals. Neither the Austrian, the guards, Don Quixote, Baron Munchausen or animals have the intention to create a ludicrous situation. This is different from intentional wit or telling a humorous story or joke. Schopenhauer states that it should be both true for the first and the second view of his categories: "Now the more correct the subsumption of such objects under a concept may be from one point of view, and the greater and more glaring their incongruity with it, from another point of view, the greater is the ludicrous effect which is produced by this contrast."

Together with Kant and Schopenhauer, Søren Kierkegaard (1813–1855) has been mentioned as a philosopher who contributed to the incongruity view on humour. However, as in the case of Kant, Kierkegaard only offers some general remarks on incongruities; there is no development of thoughts about incongruities. Kierkegaard's and Kant's observations do not add to what has been said about humorous incongruities by the early British philosophers and essayists on humour. In Kierkegaard's 1846 publication [36], the word 'contradiction' can be interpreted as 'incongruity'. The 'comical' is the disparity between what is expected and what is experienced, and "The comic is present in every stage of life ... , for wherever there is life there is contradiction, and where there is contradiction the comic is present." This is more or less all Kierkegaard has to say about the characterization of humorous incongruities.

4.3 Alexander Bain and Herbert Spencer on energy management and incongruity

In 1859 the Scottish philosopher Alexander Bain (1818–1903) elaborated on Hobbes' 'sudden glory' theory by adding a 'sudden release' from constraints, hence, in addition to the feeling of superiority, introducing a 'let off steam' function of humour [37]. Bain discusses 'ludicrous degradation as a mode of release from constraint', a reaction from the serious, leading to a 'blessed relief'. Earlier, in October 1847, Bain published a piece in the *Westminster Review* on "Wit and Humour" in which he provided his view on humorous incongruities: "But the more perfect the fusion of the two hostile ingredients, or the more impossible it is rendered to think of them separately, the surer is the ludicrous effect." Bain emphasizes the ludicrous aspect of degradation that is associated with humour.

In a note added later (3rd Edition, 1875), a reference to Herbert Spencer (1820–1903) can be found. Spencer [38] mentions the release or overflow of pent-up nervous energy that is related to expectations that are not confirmed but rather contrasted. He introduces the ideas of descending and ascending incongruities. Humour requires a descending incongruity, that is, a contrast between something dignified (what we expect) and something trivial or

disreputable (what turns out to be the case). Clearly we can see the superiority element in this.[2] Ascending incongruities are not humorous. The following citation has been attributed to Spencer: "humour consists essentially in the abrupt transition of thought from a noble or elevated idea to a trivial or degrading one." The superiority point of view assumes a 'sudden glory'. According to Bain and Spencer, there is also a 'letting off steam' or relief function of humour.

5 Entering the twentieth century: Freud and Bergson on incongruities

5.1 Freud on incongruities

In particular, Sigmund Freud (1856–1939) [39] elaborated on the relief function of humour. While the previous humour researchers and philosophers were more interested in sophisticated wit and hardly made reference to vulgar and banal jokes, Freud used such verbal jokes to illustrate his theory about getting satisfaction from 'forbidden pleasures', that is, being exposed to taboo topics in jokes and enjoying them with friends and colleagues. Freud's relief point of view on humour emphasizes this function of humour, which allows us to play with social taboos and to disrupt social conventions by ridiculing them. We should perhaps add that humour provides us with a temporary feeling of superiority over such conventions.

In his 1859 book, Bain focused (as did Spencer (1860) and Freud (1905)) on the function of humour and the release of tension and energy rather than on stimuli that can be considered humorous and lead to amusement. We might irreverently state, as has been done by others, that these authors put forth theories of energy management rather than humour. Nevertheless, Bain and Spencer mention incongruities that cause humour, and Freud considers various examples of incongruities to support his relief theory. Apart from Bain, Freud does not mention other British philosophers or essayists who published on wit and humour; for example, there is no reference to Hobbes who should be well-known then. Freud offers some obligatory references to Kant, and he mentions Bergson (see the next section) and some German writers and philosophers who are now almost forgotten.

Freud makes reference to the incongruities that constitute humour and cause laughter. He mentions Bain's 'ludicrous degradation' view on humour. However, he also states the following: "It is a necessary condition for generating the comic that we should be obliged, simultaneously or in rapid succession, to apply to one and the same act of ideation two different ideational methods, between which the 'comparison' is then made and the comic difference emerges." Here, we detect Freud's appreciation of incongruities. Freud mentions the 'double face': "Mélinand (1895), from whom I have borrowed this phrase, states the determinants of laughter in the following formula: 'Ce qui fait rire c'est ce qui est à la fois, d'un cote, absurde et de l' autre, familier' ['What makes one laugh is what is on the one hand absurd, and on the other familiar.']" See [40]. Moreover, although Freud emphasizes the relief point of view, he also mentions Bergson's definition of a comic situation: "A situation is always comic when it belongs at the same time to two series of events that are absolutely independent, and where it can be interpreted simultaneously in two quite different senses." This is Bergson's 'reciprocal interference of series' view on humour that in its simplest form (each series consisting of one event) amounts to incongruity. We discuss Bergson's view in

[2] Obviously, we can find the idea of a descending incongruity also back in Michael J. Apter's reversal theory approach to humour. A nice explanation can be found in [5].

the next section. However, from these citations, we can decide that Freud also adheres to the incongruity perspective of humour. Hence, Freud does not introduce a new viewpoint on what constitutes humour, rather, he seems to be perfectly happy with the incongruity perspective of humour; in his observations, he focuses on the function of humour, that is, why people use humour.

5.2 Henri Bergson (1859–1941) on incongruities

5.2.1 Bergson's "The comic element in actions and situations"

In his "Le Rire" (1900) the French philosopher Henri Bergson emphasizes a 'mechanical' viewpoint when defining the conditions that are necessary for the comic to appear [41]. Authors usually explain Bergson's views on humour from a superiority point of view. One of Bergson's remarks is that "We laugh every time a person gives us the impression of being a thing." Indeed, we feel superior to 'things'. However, the same remark can be given an explanation from an incongruity perspective, that is, we have two opposing views with regard to a person. We can conclude the same from Bergson's observation that "something mechanical encrusted upon the living" is the usual cause of laughter. In addition to a superiority view, there is incongruity when a dignified person slips on a banana peel and loses control of his limbs and balance. It makes us laugh. Absent-mindedness and rigidity in thinking can be the causes of comic behavior or comic and absurd views on life, society, the world or nature. When a person does not adapt to new circumstances or information, his or her behavior can be incongruous with the new situation. Automatisms can go wrong, but why do they go wrong?

Bergson exploits his view in discussing the comic elements of observing form (e.g., facial expressions or caricatures), gestures, movements, and attitudes. He discusses 'mechanical' views on events in society or nature. Bergson's 'mechanical' view assumes that we think in stereotypes and are surprised by contradictions to such stereotypes. We may be aware of such a contradiction and turn it into a witty remark that makes others laugh *with* us, or we may not be aware of a contradiction and make a stupid remark that makes others laugh *at* us.

In his essay, Bergson addresses wit and the comic playwright in a chapter on the comic element in actions and situations and the comic element in language. Our interest is mainly in the comic element in actions and situations in real life. Actions and situations that spontaneously occur can have comic effects, and actions and situations can be created to achieve comic effects. We can comment on situations and events with witty remarks (intended wit) or with absurd remarks that show our stupidity. Bergson mentions that although comedy appears in real life, it is better to study and analyse it in the context of comedy stage performances. For example, the Molière comedies of the 17th century are games that imitate life. Hence, Bergson notes that "Assuming that the stage is both a magnified and a simplified view of life, we shall find that comedy is capable of furnishing us with more information than real life on this part of our subject." Comedy imitates life. Bergson presents three methods that he thinks describe all of the ways in which comic events can be created. This approach clearly distinguishes him from other humour philosophers who focus on what makes us experience an event as comic or humoristic. The three methods mentioned by Bergson are the repetition of events (e.g., snowball effect), the inversion of events (e.g., introducing things that are the opposite of the norm) and the reciprocal interference of (sequences of) events. The first two methods include aspects of incongruity. Perhaps his view on repetition needs some explanation. For Bergson the comical follows from the incongruity of 'something mechanical in something living'. Hence, Bergson formulates a law:

"The attitudes, gestures and movements of the human body are laughable in exact proportion as that body reminds us of a mere machine." In Bergson's view real life is the complete negation of repetition. Hence, if there is repetition in gestures or events then we look upon it as being produced machine-like, that is as mechanical behavior that contrasts natural human behavior. Bergson's third method explicitly addresses incongruity. As mentioned in the above section on Freud: "A situation is always comic when it belongs at the same time to two series of events that are absolutely independent, and where it can be interpreted simultaneously in two quite different senses." Hence, we have a juxtaposition of events. All three viewpoints address incongruities.

Bergson views about humour have been inspired by French comedies. These comedies include a long narrative and many comic events that are part of the narrative. There is repetition, and there is inversion. Events are related; we have references to previous events, and we can distinguish sequences of events. A comic play writer can deliberately design equivocal situations that lead to humorous misunderstandings between actors in the play. It can be humorous when the actors become aware of their different interpretations of a particular situation. Above all, their behavior is humorous for the spectator, who has a comprehensive view of the action. This perspective allows the spectator to laugh about confrontations between persons and their opposing aims and contrasting views on a particular situation and who must nevertheless stay together. With the reciprocal interference of (sequences of) events, Bergson attempts to define a situation in which two sequences of events overlap and perhaps diverge, only to converge again. The convergence of events creates an equivocal situation in which different people act in ways that correspond with their conflicting views on the situation.

Bergson does not mention incongruity; however, he does mention Immanuel Kant and Herbert Spencer and their viewpoints on humour, which also include incongruity. He accuses philosophers before his time of having too limited of a view on humour and equivocal situations. In a joke with a set-up and a punchline, we have an incongruity. This is because we have first been guided into a stereotypical interpretation of a particular situation or event, that is, the set-up, and the punch line tells us that we have misinterpreted that situation or event and must reinterpret it. Hence, we read about a particular situation, we are told about a particular situation, or we observe a particular situation. Because of newly incoming information, we must change our initial interpretation of the situation, and when this interpretation is opposite to what we had previously thought, we are amused. However, this is not always the case; rather than experiencing enjoyment, we can become confused, not knowing how to handle such conflicting views. Hence, following Schopenhauer, we have two instantiations of one concept, and we recognize that the second better fits the situation and replaces the first one. Bergson does not mention Beattie or Schopenhauer; however, his 'mechanical viewpoint' focuses on the incongruity between mechanicality and elasticity, which is a meta-viewpoint that he uses as a template for many perceived incongruities in real life and on stage. Bergson also has views on sequences of events that can become the object of amusement.

5.2.2 Incongruity and Bergson's 'Reciprocal interference of series'

Humour based on misunderstandings or ambiguities in sequences of events have hardly been addressed by humour researchers. In [42] Bergson's 'reciprocal interference of series' is described as a change from a 'quiproquo' (mistaking one thing or word for another) to prolonged 'quiproquos' (a continuous misinterpretation of the same signals by two or more characters). However, much more can be said about this, and it is worthwhile to elaborate

on Bergson's views to cover, on a meta-level, more amusing incongruous situations than are discussed above. To explain and build upon Bergson's view, we distinguish the following four cases. We do not claim to have covered all of Bergson's views on the reciprocal interference of series of events. However, the four cases upon which we want to focus are as follows:

Two or more characters who meet have a different history of recent events; that is, they have experienced a different series of events, or they have experienced the same series of events differently. When the characters enter a joint situation (their series of perceived events converge) in which they must act (perform individual tasks, perform joint tasks, interact with each other), they may have different aims. When the characters in such a situation are not aware of this and have misinterpretations of each other's aims, misunderstandings can arise; although not necessarily amusing for the characters, it can be amusing for the onlookers.

Characters who have been brought together can have different (mis)interpretations of a particular situation. Nevertheless, their interactions and activities can fit what is required in a particular situation and successfully continue, perhaps along diverging series of activities, to follow their aims without a breakdown in their activities and without being aware of their prior misinterpretations. Again, this could be amusing from the point of view of onlookers who have their own, possibly different or perhaps correct, interpretation of the situation.

Instead of a situation in which both characters (or groups of characters) misinterpret the situation (and again, onlookers may have the correct interpretation), there can be a situation in which some characters are aware of the correct interpretation and use this knowledge to profit from the situation and fool the other characters. Seeing how others are misled, even if it is done in a shrewd way, may again lead to amusement for an onlookers.

Finally, there are series of events that are intended to mislead the onlookers and lead the onlookers from one (mis)interpretation to another based on the characters' behavior.

Series of events can converge, and the intersection is a moment at which humorous (mis)interpretations occur. If there is no time, or if it is impossible to resolve all of the incongruities, there can be a temporarily diverging series of events that at a certain time converge again until there is another intersection with a new round of possible misinterpretations that are nevertheless related to the previous ones. Repetitions of alternating converging and diverging series of events add to the humorous effect. Hazlitt's remarks, made in 1818 [31] on comedy are relevant in this situation: "Wickedness is often made a substitute for wit; and in most of our good old comedies the intrigue of the plot and the double meaning of the dialogue go hand-in-hand, and keep up the ball with wonderful spirit between them."

Although this interplay of interpretations can happen in real life, it is more common in anecdotes, humorous texts, and jokes as well as on stage or in TV series and movies. A comedy writer can design such interference leading to different views for the characters or audience with regard to situations and storylines that alternate between convergence and divergence without all the characters or the audience being aware of it. A comic street artist who is performing in front of an outside-dining tourist audience can also involve unsuspecting passers-by in his play or invite audience members to play a role in their act without giving them any knowledge of what is expected of them (or giving them erroneous knowledge). Some examples of this mutual interference of series of events (or scenarios) have been analysed as 'sight gags' in the context of movies by Noël Carroll [43].

We return to observations on incongruity in the next section. However, to provide a more complete sense of Bergson's views on laughter and humour, we should mention Bergson's view that laughter serves a 'social corrective' function. In fact, Bergson hardly mentions that humour or the comic may lead to enjoyment. Rather, it serves as a warning against unwanted

behavior and attitudes. He also emphasizes the intellectual effort that is needed in resolving incongruous situations, and he emphasizes that laughter is only possible when there are no distracting emotions (anger, sadness, pity, grief). According to Bergson, laughter is incompatible with emotion. Today, Bergson's views on laughter as a social corrective seem rather extreme. Although his writings can give the impression that the comic can be enjoyed, in Bergson's writings overall there is a very negative attitude towards humour. According to him, rather than being 'inelastic' to the needs of a society, we should adapt, and the laughter that is directed at us is meant to make us adapt. Bergson asserted the following: "Now, it is the business of laughter to repress any separatist tendency. Its function is to convert rigidity into plasticity, to readapt the individual to the whole, in short, to round off the corners wherever they are met with."

However, based on Bergson's views, Atkinson [44] argues that investigations into humorous incongruities help us to reflect on various aspects of human behavior and can therefore stimulate critical thinking. A similar opinion is expressed by the Spanish cartoonist Junco [45] who emphasizes the role of (graphic) humour ('designing the incorrect') to explore what is prohibited in real life and what can be gained if we lift such prohibitions rather than force people to comply with existing social conventions. Finally, Steinert [46] discusses how Bergson's views on 'something mechanical encrusted on the living' (a person, a view, a society) and its contradiction with Bergson's 'élan vital' should be included in a philosophy of technology. Laughter and amusement can also provide insights into the shortcomings of technology, how new technology is introduced into society and how people can interact with new (digital) technology.

6 From philosophy and psychology to linguistics 'mechanisms'

6.1 The increasing popularity of jokes

As mentioned earlier, jest books were available long before philosophers tried to analyse humour and offered their observations on superiority, incongruity and relief. Early jest books contained humorous stories, anecdotes, and poems. Characters in these stories demonstrate stupid behavior, make witty remarks, and, unintentionally, create absurd situations. Humour philosophers have sometimes made use of such stories to illustrate their views on humour. More often, they have used a more abstract reasoning on incongruities in appearance, behavior, and situations, regardless of whether the actions occurred in real life, on stage or performed by jesters and humourists. William Preston provided categories of incongruities without making reference to humorous stories or comedies, and neither did many of the British philosophers who discussed humorous incongruities. Wit was a style of humour that could be used intentionally; however, the content of wit had to be created at a context-dependent appropriate moment. Ridicule was a reasoning style that introduced or made people aware of the incongruities (contradictions or impossibilities leading to absurd situations or conclusions) in an opponent's opinions and writings.

Arthur Schopenhauer considered anecdotes; however, this was done to illustrate his views on real-life absurdities, unintentional humour and more general, humorous incongruities that are not prepared in advance. Although Kant was known for his wit during dinner conversations, his views on wit and humour are superficial and superfluous in that he does not demonstrate knowledge of what has been said by the philosophers of earlier centuries. Freud built his relief theory observations mainly on prepared humour, not spontaneous humour, and not on unintentional humour as it appears in real life or as it is simulated

(and exaggerated) on stage. He used jokes to distinguish between different types of humour, and he even discussed the various techniques that are used in short verbal jokes [39]. While 18th and 19th century humour essayist and philosophers kept a distance from bawdy, scatological and sexually oriented jokes, Freud collected them and used them to illustrate and support his relief theory and observations on dreams.

In the late nineteenth century, jokes became the most visible form of 'bourgeois' humour. Newspapers and magazines introduced joke and cartoon sections, comic journals were published, and, as mentioned in [25], a joke market emerged. There was a joke trade, a joke shortage, and there were discussions about the industrial production of jokes.

From a scientific point of view, the jokes that appeared in newspapers and magazines usually consisted of a very short story (a narrative containing a few lines that set up the story) and some surprising ending in the last sentences, making one aware that one had a wrong interpretation of the initial narrative and must reinterpret it to give a plausible interpretation of the complete narrative, including a 'punchline' that contrasts our expectations. As mentioned in Wickberg [25, p.34], from a scientific point of view, the joke became a " ... fundamental unit of humour, discrete, self-contained, and subject to isolation for practical purposes of critical analysis." During these years, the view on laughter changed from hostile to good-natured, from antipathetic to sympathetic. True humour should not be about contempt, that is, about laughing 'at' but rather laughing 'with'.

Physical humour was embraced by the film industry. This was first shown in the first 'practical joke' movie, "L'Arroseur arrosé" by Louis Lumière in 1895. In the first half of the 20th century, there was an emergence of, at first 'silent' movies, and later 'sound' movies, with comedy actors such as Charlie Chaplin, Harold Lloyd, Buster Keaton, Laurel and Hardy, the Marx Brothers, and Abbott and Castello. In this period, Max Eastman wrote about humour and laughter and techniques, also inspired by his cooperation with Charlie Chaplin, that helped to induce feelings of mirth. In 1922, Eastman [47] wrote, "I suspect that the reason why so many philosophers have deemed all laughter to be of the derisive flavor is that they dreaded the prick of it. What we learn from their theories of 'sudden glory' and the 'feeling of superiority,' is that they hated to be laughed at." In 1929, Eastman [48] only mentions 'incongruity' in a footnote. Eastman also attempts to analyse jokes by introducing a notation to diagram jokes. We can learn from Eastman's observations; however, despite the many examples of (mainly verbal) humour, there is no presentation of guidelines that describe how humorous events can appear, be analysed or be generated in real life.

6.2 Towards an information processing view of jokes

In 1929, the *Encyclopaedia Britannica* included an article on humour by the British author Gilbert Keith Chesterton [49]. He provided the now-well-known observation on humour: "It is thus a term which not only refuses to be defined, but in a sense boasts of being indefinable; and it would commonly be regarded as a deficiency in humour to search for a definition of humour." We nevertheless can say that, during these years, humour became a research area on its own, in psychology rather than in philosophy. An annotated bibliography on humour in the research literature between 1900 and 1971 [50], which was published in 1972, mentions that of the nearly 400 items, less than 15% was published before 1930. From our incongruity point of view, no particularly new thoughts were developed during the periods that are covered by this bibliography. However, because of our interest in non-verbal humour, we should mention a 1940 paper in which John M. Willman [4] explores incongruity. He mentions that humour results from "the union of two ideas which involve some sort of contradiction or incongruity". Willmann focused on this union and thus

mentioned that it can be accomplished in three different ways: (1) two ideas may be united by possessing important common elements, (2) one idea may simply be an inference drawn from the other, or (3) they may be seen as actually occurring together in objective reality. The third observation in particular is interesting because it distinguishes Willmann from other researchers who focus on 'just' verbal humour. As mentioned by Willmann, this class of humour is about incidents that "must be seen to be appreciated" and "no verbal description can really make such things seem funny ... ". Indeed, as we sometimes say: You had to be there to know why it was funny.

The humour research became embedded in the psychology research. In 1972, the "Psychology of Humor" [50] was published. It was a large collection of research chapters with the aim "to stimulate increased empirical interest in an old and troublesome topic." A few years later, in 1976, the British Psychological Society organized the first large-scale International Conference on Humour & Laughter in Cardiff, Wales [51]. Among the chapters in [50] that address the incongruity, cognition, physiological correlates, and social functions of humour, one chapter stands out as it presents an 'information-processing analysis' of jokes and cartoon humour. In it Jerry M. Suls [52] introduced a two-stage model for the appreciation of jokes in which he analysed a joke's incongruity and the resolution of incongruity using an information processing flowchart model and ideas from computational problem-solving as introduced in the context of artificial intelligence by Allen Newell and Herbert Simon in 1958. Digital technology had emerged during the fifties and sixties of the previous century. During the Second World War and in the following years, our first computers computed the tracks of ballistic missiles, helped to decode cryptographic messages and computed the functioning of atomic bombs. In the 1950s, there was much optimism about algorithmic approaches to modelling human intelligence. Such approaches included computers that could understand speech and natural language and translate from one language to another, computers that could see and understand what they see, and computers that processed human-made algorithms that performed human-like reasoning. Unfortunately, human-made algorithms require human knowledge and the formalization of this knowledge before it can be captured in algorithms.

Artificial intelligence (AI) research received a great deal of attention during the second half of the twentieth century. Knowledge representation formalisms and methods for reasoning about knowledge were introduced. Marvin Minsky [53] introduced 'frames' in 1974, and Roger Schank [54] introduced scripts in 1977. These knowledge representation formalisms were designed to model stereotypical situations in real life. Minsky [55] in particular made it clear that to analyse and understand humour, we require knowledge representation formalisms that model our common sense knowledge and that allow reasoning about such knowledge. Minsky considered humour to be a force that can cause us to change our opinions. Humour attacks 'bugs' in our reasoning, making us aware of how knowledge representation formalisms should allow for and be aware of reasoning that detects deception as well as nonliteral and metaphorical language use.

Victor Raskin [56] introduced what he called a script-oriented semantic theory of (verbal) humour, in which scripts represent 'common-sense' knowledge and a joke can be explained by an overlap of two or more scripts that are compatible with the joke, and the humorous effect is produced when, due to the punchline, we must make a shift from the script that represents the initial interpretation to a script that represents the more correct but initially unexpected interpretation and there is opposition in the 'main' features of the two scripts. A now-well-known example that is used by Raskin to illustrate this view is the constructed 'Doctor versus Lover' joke:

"Is the doctor at home?" the patient asked in his bronchial whisper. "No," the doctor's young and pretty wife whispered in reply. "Come right on in."

There are the overlapping visiting DOCTOR and visiting LOVER scripts; they are sufficiently opposed (medical examination versus making love), and we can also discuss a type of (stereotypical) degradation of the doctor's wife status (not mentioned by Raskin).

A book-length treatment of Raskin's Semantic Script Theory of Humour (SSTH) appeared in 1985 [57], followed by more detailed definitions leading to the general theory of verbal humour (GTVH) [58] and models of script opposition (dead versus alive, poor versus rich, young versus old) using ontologies of word and world knowledge [59]. As noted above, earlier researchers such as Hutcheson, Morris, Preston, and Spencer also mentioned the necessity of having opposite interpretations and sometimes gave examples. Bergson distinguished between proper and improper social behavior, between human and animal, the natural and the mechanical, and, most of all, the elastic and the inelastic (mechanical).

Raskin [56] does not argue that a complete 'scriptization' of reality is possible. An algorithmic understanding of jokes also requires the detection of the appropriate opposing scripts in a joke and when it is not about analysis but about the generation of a humorous incongruity, given a particular script-based description of an event, how do we find an overlapping and sufficiently opposing script in a script database that can be used as a follow-up script? Almost forty years later, neither the joke research nor the computational linguistics research or the artificial intelligence research have provided answers.

6.3 Computing humour

In computational humour, the aim is to find and use formal models of humour that allow algorithms that tell us why something is humorous or how to generate something that will be considered humorous. If we confine ourselves to verbal humour, then computational humour is about the semantics and pragmatics of short narratives, which is not that different from the research on nonliteral and metaphorical language use, the research on ambiguous language use, and the research on deceptive language use. In joke analysis, we have a short text that provides us with an initial interpretation followed by a second interpretation that opposes the initial interpretation. State-of-the-art natural language processing does not allow us to algorithmically interpret an arbitrary short text and algorithmically decide whether the text is meant to be humorous. Further, there are no possibilities, or at least investigations into the possibilities, of generating humorous texts or punchlines that provide unexpected and humorous views on previous conversational utterances or humorous observations on what is happening in an interaction environment.

The humour approach of Raskin, Attardo, and others is about finding formal models of humour that allow for the understanding and generation of jokes, or more generally, humorous short texts that force us to replace one interpretation with an opposing second interpretation when new information becomes available. The information that allows a comprehensive understanding is provided sequentially in a text or conversation. Unfortunately, in the computational linguistics research and in the artificial-intelligence based natural language processing research, until now, it has not been possible to design algorithms that fully understand a short text, let alone a short text that is meant to deceive its reader or listener.

The 1970s saw the organization of conferences and workshops devoted to defining humour such as the above-mentioned International Conference on Humour & Laughter organized in Cardiff in 1976. A workshop on Humour and Cognition was organized by Douglas Hofstadter in 1989 [60]. In this workshop, there was again an emphasis on a script-based

approach to verbal humour, although cartoons and their captions were also among the topics of interest. We introduced the term 'Computational Humour' in 1996 when we organized the first International Workshop on Computational Humour [61] at the University of Twente, the Netherlands. The workshop was attended by all of the well-known humour researchers: Marvin Minsky, Douglas Hofstadter (using a video link), John Allen Paulos, Victor Raskin, Graeme Ritchie, Kim Binsted, Salvatore Attardo, Tony Veale, Carmen Curco, Oliviero Stock, and many others. Sequels were organized; a second one was organized by Oliviero Stock in Trento, Italy [62], and a third workshop on computational humour was organized in Amsterdam, the Netherlands [63]. In Fig. 1, we present the covers of these three workshop proceedings.

The aim of these workshops was to discuss attempts to formalize humour in such a way that computer algorithms can make us believe that a computer 'understands' humour and that computer algorithms can generate humour. The research that was reported in these workshops focused on the analysis of verbal humour (jokes, word play, irony). Computational approaches to conversational humour, non-verbal, visual and physical humour hardly received attention. Rather, there were computational linguistic approaches to irony, chatbot-like applications and the automatic generation of punning riddles [64]. In punning riddles and other types of word play, we often use syllable- or word substitution as well as phonological ambiguity to introduce a funny word or unusual term. For example, "What do you call a murderer that has fibre? A cereal killer." The use of humour in human-computer interaction was discussed in Binsted [65]. Experiments by Clifford Nass and his team showed the positive effects of the use of humour in computer-mediated communication tasks [66].

The construction of humorous acts in conversational human-computer interaction was discussed in [67], where the focus was on the interaction with (embodied) conversational agents that needed a sense of humour. We mentioned above that this conversational humorous act construction requires appropriateness considerations. That is, although it may be possible to construct a humorous act using information from the conversation up to that point and knowing about the context, can we nevertheless assume that making a humorous remark will be appreciated, given the topic of discussion and the mood and emotions of the conversational partners? In [68] we exploited the humorous confusion that arises when during anaphora resolution in a conversation the most unlikely antecedent is purposely chosen. Hence, when in a Dilbert cartoon during a conversation on a "strategic diversification

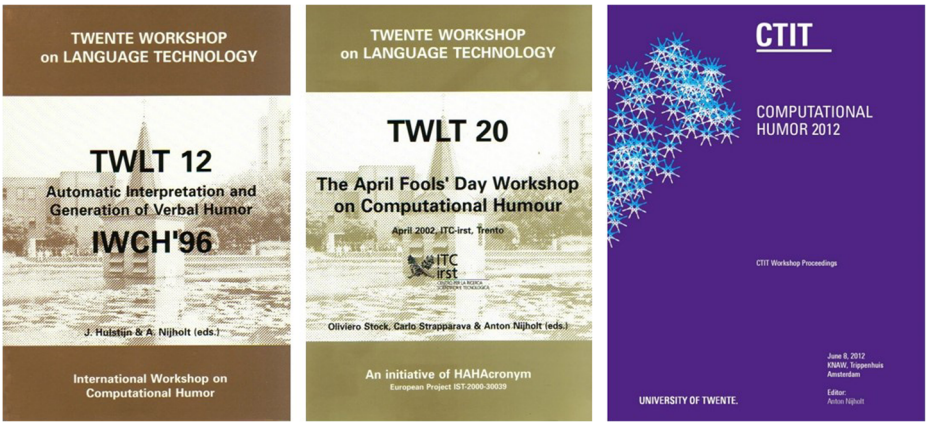

Fig. 1 Three workshops on computational humour

fund" it is mentioned that "Our lawyers put your money in little bags, then we have trained dogs bury them around town", we have our system answer with "Do they bury the bags or the lawyers?" The assumption is that the most unlikely antecedent sufficiently opposes the most likely antecedent to create a humorous incongruity. In this research, we used the Stanford parser for syntactic analysis and used a reference resolution algorithm for Dutch. Obviously, we can have a computer (social robot, chatbot, embodied agent) purposely and spontaneously generate such a misunderstanding. However, given the current state of natural language understanding by computers, such a humorous remark or question can also be generated unintentionally.

In the European funded humour project HAHAcronym [69] led by Oliviero Stock an automatic acronym re-analyser and humorous acronym generator was implemented. Specialized WordNet resources were developed, for example, with the aim of being able to introduce an incongruity between the original acronym's meaning and a new meaning with the goal of being humorous. As an example, rather than providing M.I.T. with the meaning "Massachusetts Institute of Technology," the new opposing interpretation became "Massachusetts Institute of Theology." Despite its limitations caused by poor funding, this first funded international research project on humour helped to build a computational humour community. The project helped to initiate investigations in conversational humour as mentioned above [67] and the use of machine learning techniques to detect humour in texts. That is, machine learning techniques using large data sets showed the possibility of distinguishing between humorous and non-humorous texts, at least recognition of the type of humour in one-liners such as "Beauty is in the eye of the beer holder" [70]. At that time, advertisements were seen as a possible application area for this research.

Other, more recent, approaches to computational humour have been initiated by Oliviero Stock. They are more clever implementations of the ideas that were used to generate humorous acronyms or attempts to distinguish humorous one-liners from other texts. That is, it addresses funny newspaper headlines [71], funny lyrics [72] and funny Twitter retweets [73]. These approaches remain in the linguistically bounded domain. Initially, they are not directly about contextual features that can play a role in a humorous interaction or in events in our physical environment to which we would like to provide a humorous interpretation or express a humorous comment to a conversational partner. Nevertheless, these rule-based and machine-learning approaches to linguistic mechanisms and the aim of generating humour rather than analysing humour help us to explore the generation of humour in other-than-linguistic realities.

7 Humour research oriented towards physical environments

Here, we summarize how the past research has addressed humour as it can appear in physical environments rather than addressing humour from a purely linguistic point of view. From Sections 3, 4 and 5 it has become clear that before the twentieth century, in the humour research, the emphasis was not on jokes or other forms of linguistic humour but on non-verbal humour. Of course, there were humorous stories, anecdotes, humour in literature and on stage; however, in these cases, the emphasis was often on the actions that were performed by the actors. In Section 3, we outlined Hutcheson's explicit description of humorous incongruity (1725) and his addressing of incongruities in ideas, thoughts, behavior, events, circumstances, and in the characteristics of objects and persons. Akenside [18] mentioned that an object can be incongruous in its environment, and Morris [20] discussed the humour (wit) in a picture or a landscape. Moreover, we saw Beattie's (1779) systematic

approach with his four types of incongruity structures and Preston's [23] four categories of humorous incongruities. In Section 4, we presented Schopenhauer's (1818/1819) discussion of intentional and unintentional forms of humour and absurd situations. In Section 5, we covered Bergson's (1900) play with interpretations that were hidden in his thinking about mutual interference of series of events.

Today, we can find observations from researchers on humour in cartoons, movies, comedies, TV series, commercials, and videogames. However, research that considers humour that is intentionally or unintentionally based on (digital) technology is not or is hardly available. In the next section, we consider humour in digitally enhanced physical environments.

In 1976, Arthur Asa Berger [74] introduced categories and techniques of humour. They "were elicited by making a content analysis of all types of humour of various media." The basic categories were (1) Language: humour is verbal, (2) Logic: humour is ideational, (3) Identity: humour is existential, and (4) Action: humour is physical or non-verbal. Although many of the incongruities in the second and third categories are expressed using language, some of them are more general and can also take different forms, for example, logic play, mistakes, repetition, accidents, mimicry, and impersonation. In [75], Berger's categories were used to design a typology for humour in television commercials that led to the categories (1) slapstick, (2) clownesque humour, (3) surprise, (4) misunderstanding, (5) irony, (6) satire and (7) parody. In [43], Noël Carroll discusses the visual humour in movies, so-called 'sight gags', which are usually a play of interpretations in which the interpretations are visually available. Here, we can find Bergson's mutual interference of series of events (scenarios) and mimed metaphors (for example, Charlie Chaplin treats a boot as a meal). Carroll's observations are mainly on the silent movies in the first decades of the twentieth century. Obviously, there can be an interplay between audio and visuals, for example, the scene in *A Fish Called Wanda* (1988) in which John Cleese, playing a British lawyer, is dangerously hanged from a window by a thug who he previously insulted and then apologizes in extreme lawyerly language. There is incongruity between the use of that type of language and the dangerous and stressful situation where one would expect more emotional behaviour. Hence, as mentioned in [76] the situation does not require or even allow formal and juridical language. There is a cross-modal incongruity.[3]

These typologies and associated humour techniques were based on humour as it appeared in media, and although the contents of media can present real-life occurrences of humour, media also allow a manipulation of content that cannot be achieved in 'real life' (eating a boot, hang someone head-down outside a window). In the next section, we discuss humour in digitally augmented physical worlds (smart environments), and we consider the possibility of supporting humour creation through digital media technology as well as manipulation of the real world.

Another example of a typology is given by John Morreall [77] in 1983 (the summarization below is from [78]). Morreall distinguishes between incongruity in 'things' (objects, persons, situations) and incongruity in 'presentation' (speech and language). In the former, he focuses on situations and events that can also occur in digitally augmented physical situations and events. In his five main categories, we can recognize many of the incongruities mentioned above.

[3] As mentioned by a referee the scene includes more incongruities. There is the sight gag (a 'switch image' [43]) with a camera viewpoint that first makes you believe that Cleese is standing on a window ledge rather than, as shown in the next scene, hanging from the ledge. Moreover, using juridical language to apologize to a thug is incongruous.

Deficiency in an object, action or person. This is about physical deformity, ignorance or stupidity, moral shortcomings, or actions that fail. Hence, it is about inferiority, weakness and absent-mindedness. In the case of actions that fail or are performed awkwardly, it can also be due to a defective tool or a chance event. In a practical joke, someone deliberately causes a failure of action.

One thing/situation seeming to be another. This is about mimicry/imitation, imposters, pretence, and mistaken identity. Comedies often depend on mistaken identity or situations. Anthropomorphizing animals, inanimate things or sequences of events also belong to this category.

Coincidence in things/situations. This includes unexpected repetition in events or, for example, in comedy, in lines. Everywhere we expect uniqueness, unexpected repetition can have a humorous effect.

Incongruous juxtaposition. The incongruous effect is obtained by having physical, social, and psychological opposites appear together in a situation. In a comedy team, we can have physical differences (short versus tall, thin versus fat) and personality differences that help lead to funny situations. However, incongruous juxtaposition also occurs when, for example, a vagabond has dinner in an expensive restaurant.

The presence of things in appropriate situations. This category can be generalized to the presence of 'things' (objects, people, behavior, opinions) in situations where they can be considered to be inappropriate or situations in which sequences of events inappropriately intersect.

When designing or creating humour in the physical world, we can be inspired by the categories mentioned above [74, 75, 77]. It is also possible to focus on a particular 'thing', for example, 'things' that are physical objects, persons, behaviours, acts, or interactions, and identify further detail in this categorizing of incongruities. For example, we can learn from more detailed observations on the incongruity in humorous product design. What types of incongruities can we apply in the design of humorous products? This has been investigated in various papers, and it has led to additional views on incongruity that can help to obtain a more comprehensive, systematic and well-structured categorizing of humorousness or potentially humorous incongruities. Geke Ludden and co-authors [79] considered cross-modal incongruities. When we consider a product and see, hear, smell, taste or touch it, we have certain expectations, for example, the smell may suggest a certain taste, and the appearance may suggest a certain tactile experience. When we squeeze a rubber duck and it roars like a lion, we have an incongruity between appearance and sound, that is, an audio-visual incongruity. A candy that looks like a banana can be given a very sour taste. Rather than incongruities that confuse us, make us angry or make us afraid, we need cross-modal incongruities that amuse us. It is suggested that association maps can help identify amusing cross-modal product incongruities. An association map displays the relationships between objects and their characteristics. A rubber ducky is associated with a lion (animal, colour, making sounds); there is overlap between the characteristics, and by exchanging a contrasting characteristic, we may obtain a humorous effect. Visual-tactile incongruities are studied in [80]. A survey of various sensorial (tactile, olfactory, gustatory, auditory, visual) cross-modal incongruities can be found in [81].

Yu and Nam [82, 83] introduce yet another way to introduce product incongruities. They suggest a bathroom mat that looks like it is made of egg shells; thus, at first sight, one is afraid to step on it. In an empirical study, they distinguish three aspects of an amusing product experience. They include the 'representational aspect' (shape, tactile, colour), the 'operational aspect' (functioning) and the 'aspect of context of use'. The bathroom mat example shows a 'representational' or shape incongruity. When the expected situation of

use, for example, through its appearance, differs from the actual situation of use, we have a 'context of use' incongruity. When a product has an unexpected function, we have an 'operational aspect' incongruity.

It should be clear that in future research on incongruities, attention should be paid to integrating the various views that are available in the current typologies to make them more useful for analysing and creating humour in non-linguistic contexts. Also missing are the elements of daily experiences that make us smile or laugh. Today, many people share their daily experiences with others on social media. This allows for a study of those experiences from the perspective of humour point. An example of such a study is [84], in which travel blogs are used for the analysis of humorous episodes.

8 Towards a research program for designing humour in smart environments

Current typologies characterize humorous activity and humorous techniques in worlds where digital technology does not play a role. This is also true for the typology of humour in audio-visual media [75] since it concerns the representation of (non-digitally enhanced) real-life situations in TV commercials. How can we incorporate digital technology in our typologies of humour techniques and humorous incongruities? More importantly, what is the impact of digital technology on future humour experiences? Will there be more humour or other humour when our everyday lives, travel and leisure experiences change? Can we use digital technology to create more humour experiences? Can we provide digital technology (social robots, virtual agents, smart environments, the Internet of Things) with a sense of humour so that it provides us with humour of its own? In this section, we offer some thoughts about the role of sensors and actuators (including robots) in the creation and experiencing of humour.

Sensors and actuators become embedded in the 'things' that surround us. We can interact with these Internet-connected 'things', tell them what to do and how they should take care of our preferences. Rather than explicitly telling them what we want and prefer, (artificial) intelligence has been programmed in the 'things,' is available in the computers that control them and can also learn from our behavior. The 'things' embedded in the Internet of Things include walls, furniture, vehicles, wearables, and, in fact, all everyday objects in the environments that we encounter when we are active in our house, travel to work, do our work, or engage in sports and leisure activities. Sensors that monitor such activities can be smart due to embedded computing capabilities or being connected to such capabilities. Actuators are smart for the same reasons; their behavior is controlled, adapted and activated by what is sensed and interpreted, and the results of such interpretation lead to actuation and changes in the environment. Changes can be physical; a door can open because of a proximity sensor; however, changes can also refer to the behavior of (conversational) embodied agents in a virtual or augmented realty environment or a social robot performing in its physical world.

In a smart environment, we can have accidental and unintentional humour. Various types of such humour can be expected [8, 9]. There can be bugs and malfunctions that lead to humorous situations. Human inhabitants can use the technology in unforeseen ways, and they can misunderstand what is expected from them. Weaknesses in a smart environment can be exploited by users or hackers to introduce surprising situations for future users. Robots acting in smart environments can exhibit humorous behavior for human observers when they are compelled to recover from erroneous physical behavior or interactions. Designing some

arbitrariness in the behavior of smart environment technology can help make humorous situations appear.

A smart environment allows for the enacting of mischievous pranks [85]. Those with access to sensors and actuators can configure them to introduce a humorous situation. If the smart environment has a sense of humour, it can decide on its own to configure its sensors and actuators in such a way that a human inhabitant can observe a humorous situation or become the butt of a humorous situation. A smart environment with a sense of humour can inform a human inhabitant about opportunities to create a humorous situation or to make a witty remark with regard to a particular situation.

In addition to the smart environment and its human users, we can distinguish human-like inhabitants such as virtual or holographic agents and social robots with a physical appearance. Robots, particularly social robots, will become part of our everyday lives. Although they are not necessarily humanlike in their appearance, they must support human activities, collaborate with humans or compete with humans. These robots will have humanlike behavioural characteristics, and other humanlike properties will be assigned to them based on anthropomorphism. Understanding human behavior is expected from social robots. Displaying human-like behavior, for example to make clear that a human partner is understood, is also expected. Affect, emotions, and empathy are topics that are researched in the human-computer interaction research. Understanding humour and, when appropriate, generating humour is necessary for human-robot or human-virtual-agent interaction. Corresponding non-verbal behavior also must be modelled.

When social robots move around in our environments and engage with us in conversational and non-verbal interactions, their humanlike behavior invites us to treat them as humans, inviting small talk, exchanging information about our family, our moods and emotions, and making humorous remarks. Making humorous remarks or commenting on a particular situation is only one of many possible ways to create humour with a robot partner. The robot can be made the butt of a joke, for example because of its clumsy and imperfect behavior. However, when a social robot is sufficiently integrated into a domestic space, public space or workplace environment, we can also expect that it may be asked to participate in creating a humorous situation or use its (computational) sense of humour to take the initiative to create a humorous situation and make a human partner the butt of a joke. Clearly, a social robot that is part of the Internet of Things has many possibilities for configuring an environment, its objects, devices, its own role and its expected human behavior into potentially humorous events. However, rather than using this knowledge to make physical changes to an environment, it can also make comments that provide an unexpected and humorous interpretation of what is happening or, perhaps more importantly, what could happen.

The following, slightly overlapping, questions can be helpful in designing a research program that aims at introducing humour in smart environments. Our questions are not concerned with joke telling or listening to jokes.

How can sensors and actuators be used to configure the (digitally enhanced) real world, in the same way we can use words (and timing, prosody, gestures), with the aim of creating humorous incongruities in our smart environments?

How can the intelligence of social robots, virtual agents, and smart environments introduce conditions that help to facilitate humour-creation by humans? Can such environments and artificial agents generate humorous events themselves?

How can sensors and artificial intelligence be used to detect events that allow a humorous interpretation and suggest this interpretation to their users? Suggestions can be done by a

personal agent that is invisible to others and tuned to a sense of humour that belongs to the agent's owner.

Can we use smart technology to increase the chances of unintentional humour to appear? Can we introduce 'digital banana peels' that are waiting for someone to step on it? Who will be the audience? Bugs, incompetence and unfamiliarity with new technology can lead to humorous situations. How to exploit that? Digital mischief humor can be humorous for its designers, but not necessarily for its victims, that is those who are the butts of a mischievous act [85].

Rather than offering answers to these questions here, we think this paper illustrates that such questions are worth investigating. Investigating humour in a digitally enhanced world requires the development of ideas about how such technology can be used to create, support, or facilitate humour-creation. This includes the automatic generation of humour using digital technology or occurrences of humour that are not intentional and not designed in advance. These latter incongruities can arise due to digital bugs and humans inhabiting smart environments that make errors when using digital technology.

9 Discussion and conclusions

The present state of the humour research does not yet allow us to fit our smart environments, virtual agents, and social robots with a humanlike sense of humour. The problem of modelling humour in such a way that it can be generated and understood by a computer or robot has been called an AI-complete problem. AI-completeness is an idea that was inspired by the NP-completeness definition in computational theory. In this theory, a particular class of problems (NP-complete problems) cannot have an efficient algorithmic solution unless we can prove that one of the problems can be solved efficiently. Until now, no-one has been able to find such an efficient algorithm for one of these famous problems. Until now, no-one has been able to find a computational model of humour that allows us to make a computer understand or generate humour. If we were able to do so, this AI-completeness view indicates that we would then be able to solve all problems related to an algorithmic modelling of human knowledge, intelligence and behavior. Unfortunately, as is the case in 'artificial general intelligence', we are not yet able to model all human knowledge and behavior, and we are not yet able to consider it in a way that is required to understand and introduce unusual, surprising and humorous acts in human-human interaction or in events, whether they occur intentionally, unintentionally, or accidentally.

Humour is a less developed research area in affective and ubiquitous computing; however, because of its role in human-human interaction, it requires a similar research effort as that which is now present in other affective and cognitive aspects of human-human interaction and the transfer of such research results to human-computer and human-robot interaction. In present-day research on modelling humour the emphasis is on jokes, and the aim is to understand why a joke text is humorous, that is, how it leads to amusement or laughter. The joke research has not been successful, and no formal models for joke understanding have been obtained. Moreover, we think it is more useful for smart environments, wearables, social robots and virtual agents to detect, understand and be able to comment on funny social situations, make situations humorous by providing an alternative and unexpected view, or by manipulating a situation using its sensors and actuators such that it becomes humorous. We can do better than having social robots that recite jokes. For these reasons, we think it is useful to review the treatises on humour by essayists, philosophers

and psychologists from the 18th to the 20th centuries who did not focus on prepared humour such as jokes and pranks.

In a (digitally enhanced) physical environment, we can be confronted with unexpected and sudden changes caused by smart digital technology that requires us to reinterpret a particular situation and recognize it as humorous. This is a rather general description of the incongruity point-of view of humour. It can be used to describe jokes (linguistic humour) but also to explain cartoons (visual and linguistic humour) and humorous situations in movies (audio-visual humour) or humorous situations in real life. Today, and even more in the future, humour 'in real life' will refer not only to face-to-face situations but also to email messages and social media (Facebook, Instagram, Snapchat, Twitter, YouTube) and, as discussed above, humour that arises due to the capabilities and presence of sensors, actuators, social robots and virtual agents.

What types of humorous incongruities can appear or be created? Throughout this paper, we have addressed views on incongruity and examples or classes of incongruities. However, the current typologies characterize humorous activity and humorous techniques in worlds where digital technology does not play a role. Humour, play and games in urban environments using digital technology are topics that have more recently received attention [8, 78, 85]. New technology allows for the digital manipulation and communication of sensory information that addresses all or some senses rather than only parsing digital audio-visual information. Actuators can make physical changes in our environments, and augmented and virtual reality can augment our physical spaces in realistic and non-realistic ways. This allows for the creation of illusions and incongruities. Existing typologies of incongruities must be extended and integrated and require a firmer basis and systematic design to become useful to analyse and create humour in smart environments.

In almost all explanations of wit and humour, essayists, philosophers and psychologists make reference to aspects of degradation (superiority), relief (enjoyment, release of emotional energy), and incongruities that are comic. Moreover, observations have been made on the strong emotions that can prevent the appreciation of the comic and that the comic can only be appreciated in a 'safe' situation. Even if we are the butt of the humour, it must occur in a situation in which we are with friends or family members, and the humour is not truly a face-threatening act. Also, Freud does not disagree with the incongruity point of view of humour. His focus is on the emotional effect of humour. The British philosophers who focused on incongruity do not disagree with mirthful disposition or the degrading viewpoint on humour. Indeed, there are various viewpoints; however, none of them exclude the others, despite differences in taste and the social role of humour. Remarkable in the humour research literature is that the introduction of the incongruity point of view on humour is also often attributed to Kant and Kierkegaard. This attribution is not correct as we have shown in some sections of this paper. Not only did they not introduce this point of view, but they also mystified it while offering less clear explanations than had already been provided by British philosophers and essayists. We also showed that philosophers who are mainly known because of their superiority or relief views on humour also adhere to the incongruity point of view.

When humorous incongruities are introduced in smart environments, we should be aware of the above-mentioned social and emotional consequences that are related to the relief and superiority aspects of humour. We, or rather the smartness in our environments, must take care of conditions that make unexpected events 'non-threatening'. However, we cannot exclude the use of humour in smart environments that is meant to be socially corrective (Big Brother making humour) or mischievous and not appreciated. There can be creative use of sensors and actuators to produce mischievous humour, and there can also be unauthorized

uses of sensors and actuators by hackers who create humour that is not appreciated by anyone confronted with it.

Based on our observations of the humour research and the smart technology research, we have posed several research questions that we think must be addressed in the humour research to escape from today's joke-oriented and not-very-successful computational humour research. This approach will allow future studies to profit from the current research that introduces smartness in human-computer interaction, the ubiquitous computing (Internet of Things) research and the work that focuses on the modelling of affect in the human-computer interaction research.

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