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# Acoustic exposure and fire: an analysis of 'correfocs' in Barcelona

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In Catalunya, devils are people belonging to a 'Colla' (a group partaking in fire and drumming street performances called a 'Correfoc'). Many devils are part of a 'colla' for decades, thus exposing their hearing to extreme levels of sound several times a year. This can result in aural diversity and health being negatively impacted by the sound devils willingly expose themselves to. This paper examines the intricacy behind the sense of belonging and why the health impacts do not seem to deter participation in 'correfocs', a temporary making of place in the city. It also explores why are fireworks' producers keeping their product so loud. The methodology has been a combination between quantitative methods (survey to 'colles' to gather information on placemaking and sensory perception and the sense of community) with qualitative methods (interviews to devils and pyrotechnic manufacturers). There is also an autoethnographic component during fire season 2022. There is a strong sense of belonging ascribed to a 'colla' and this influences devils to oversee their personal health. There is a tradition to pyrotechnical artifacts loudness that is now under review by the city, but change will be slow. The paper concludes proposing an aurally sustainable approach to partaking in this inherent element of Catalan popular culture. The originality of this paper is its trans-disciplinary approach (between urban sociology, aural studies, and sensory studies) and the bodily effects of place-making during a correfoc.

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### Introduction: initial context

Catalunya (one of the autonomous communities in Spain) has a longstanding tradition of using fire in some form or another in popular cultural contexts. Fire has been present since before the XIV<sup>th</sup> century, but it is recorded in the 1424 “Book of Solemnities” in Barcelona (Crespi i Vallbona, 2003). It started as a presence in religious festivities, evolving from the Corpus or solemnities, religious celebrations where there were urban entourages going around areas of the city, and there would sometimes be some pyrotechnic artifact lit or a Fire Beast used in the representations (Palomar, 2013; Crespi i Vallbona, 2003). These uses of fire have evolved in Catalunya until the actual presence of fire in popular culture; it is deeply entwined in it (Ariño and García, 2012; Fericgla, 1990). For example, there are several occasions during the year where there will be a spectacle of fireworks one can watch from the distance, like some New Year’s fireworks but at several festivities during the year, like the 23<sup>rd</sup> June for the summer solstice. There is also a celebration that is deeply rooted in Catalan popular culture, in this paper we are going to focus on it, the ‘correfoc’ (fire run), more precisely we will focus on ‘correfocs’ in Barcelona.

A ‘correfoc’ is a fire performance where people dressed as devils run around and dance on the streets with pyrotechnic artifacts somehow like fireworks, followed by a band of drummers. Devils are people belonging to ‘colla de foc’—from now on referred to as ‘colla’ (is a social group, normally an association partaking in fire and drumming street performances called ‘correfocs’) that carry and dance with fireworks and firecrackers at the end of a wooden stick. There are several ‘colles’ in Catalunya. In some cities, like Barcelona for example, there are many, some neighborhoods having 3 or more. A ‘correfoc’ creates a temporarily very loud and visually attractive ambience; it also re-signifies the place temporally. It is a loud and rhythmic ball of fire dancing and jumping through a street. Firecrackers and pyrotechnic artifacts whistling and exploding produce sounds at high volume, sometimes reaching 175 dB. The sonic intensity of these performances has to do both with the sound emanating from the pyrotechnic artifacts and drums, and the reverberation the streets of Barcelona can create. The devils are accompanied by a drumming soundtrack played by ‘tabalers’, devils that do not burn, they play drums (Berrens, 2022; Colombo et al. 2021; Massana, 2015).

There can be different sections in each ‘colla’, for example, it can have a children’s section. This section needs a lot of assisting adults for several reasons, the first one is that individuals under the age of 18 years old are not allowed to touch F2 or F3 pyrotechnia and, as such, the adults are the ones placing the firecracker at the end of the wooden stick (‘maça’) for each devil (see figure 1). There also is a ratio of children per adult that needs to be respected during a children’s ‘correfoc’. There are also underage drummers who accompany their peers while they burn pyrotechnic artifacts. In addition, there can be a section with a Fire Beast (an anthropomorphic animal figure that is mobile and has several points to attach fireworks) having some devils outside the Beast that can burn too or not. The Beast can be accompanied by drummers, these may be from the same section as the Beast, another section in the same ‘colla’ or a different drummer group altogether. Most ‘colles’ will have adult section (devils aged over 18 years) and this section will have its own group of drummers.

Within these sections, we find that the children will carry special pyrotechnic artifacts that are less loud (normally type F1<sup>1</sup> but I will expand on this later) and are obliged to wear protective gear in their eyes with either a shield or protective glasses. They also wear gloves and are not allowed to touch or manipulate the artifacts. Adults will always accompany children to put in the pyrotechnic artifacts at the end of the ‘maça’, a long wooden stick

with a metallic spike to put the firecrackers on (Berrens, 2022) and take it off when it has exploded. In this sense, it is important to note that a child can become a devil aged 10 and they pass onto



**Fig. 1 Devil carrying a ‘maça’.** Source: Made by the author. This figure is covered by the Creative Commons Attribution 4.0 International License.

the adult section of the ‘colla’ when they turn 18. They can start drumming in the children’s section when they are 7. This is a rite of passage, both into adulthood within the ‘colla’ and into the group of people who can then manipulate pyrotechnic artifacts.

In this sense, we can see that a devil can start partaking in correfocs from a very young age and can stay in the ‘colla’ for decades, thus exposing their hearing to extreme levels of sound repeatedly every year for many years. During peak season (March–November) this exposure can happen several times a week. This results in many devils having varying levels of aural diversity and their health being negatively impacted by the sound they willingly expose themselves to. This aural diversity is often worn as a kind of “badge of belonging” and commitment to the ‘colla’ (Berrens, 2022). Belonging to a ‘colla’ and partaking in these popular culture festivities has an implication with the sense of belonging to Catalan popular culture and there is a pride ascribed to it, it also has an implication in the engagement with non-hierarchical social structures (associations) that drive bottom-up approaches to social organization and processes, spatial use, and community formation. There is a strong emotional link to the ‘colla’, and it plays a role in the identity formation of its members and the perception of the neighborhood (Berrens, 2022; Colombo and Cantó-Milà, 2019; Colombo et al. 2021). In addition, this sense of belonging develops from being part of a ‘colla’, which has similar emotional characteristics as being part of a community (Crespi i Vallbona, 2003) and from the subversion of spatial dynamics that happen during a ‘correfoc’ and the resulting temporary making of place, or a place event (Jones, 2014; Pink, 2011). When devils are doing a ‘correfoc’, the space transforms, their actions transform the space and the dance that happens between devils and spectators (and among devils) heightens the sense of belonging. Hence, when we speak of fire and belonging, we are referring to how belonging to a ‘colla’ can make some devils ignore health issues that arise from participating in ‘correfocs’ because of a sense of pride and duty towards an important element of Catalan popular culture.

This paper will first explain the different kinds of pyrotechnic artifacts typically used in a ‘correfoc’ and their construction and sonic impact. It will then analyze the data gathered from burners and the interviews with pyrotechnic artifacts’ makers. Overall, the paper examines the intricacy behind this sense of belonging and the reasons why the health impacts do not seem to deter participation in ‘correfocs’. It also examines why are manufacturers keeping their product so loud. It concludes proposing an aurally sustainable approach to partaking in this inherent element of Catalan popular culture.

## Our colla

I have been a devil since 2017 in “La Vella de Gràcia” (The Old ‘colla’ from Gràcia) and Farrófoc. The latter is a newly formed ‘colla’ in the Farró area in Barcelona, the former is one of the oldest fire groups of my neighborhood, Gràcia, in Barcelona and is the ‘colla’ I will be referring to in this paper unless otherwise stated. Our ‘colla’ has been active for over 40 years and is a “spin-off” from the ‘colla Vella de Sitges’ which is a ‘colla’ from a coastal village 40 km west of Barcelona called Sitges. The latter has been active since 1853, having continuity since 1903 (except from the Spanish Civil War years). The ‘correfoc’s’ tradition is far longer than this. It started as a play between devils and archangel Saint Michael called ‘Ball Parlat’ (Spoken Dance) and, over time, has evolved into the street celebration it is now (Berrens, 2022; Bertran, 2009; Crespi i Vallbona, 2003; Massana, 2015; Palomar, 2013; Vilarrúbias, 2018). Ours has three sections, Malsons (Nightmares), which are the children; Adulta (Adult) for people aged over 18 and Atzeries (Atzeries), which is our beast and its

devils. The beast is half devil, half buck, it is over 3 meters tall, is anthropomorphic (particularly in its manicured hands with long nails) and has several attachments for firecrackers, there are also devils that burn with the Beast while the drummers play traditional beats. All sections have devils that burn (devils from now on) and ‘tabalers’ (drummers). Both Malsons and Adulta have special “figures” (devils dressed different than the others and that use bigger maces to burn), those are Devil Lucifer and a She-devil figure (Berrens, 2022).

Malsons celebrated their 15th anniversary in May 2022 and Atzeries celebrated its on 5 May 2021. Overall, it is a very well-established ‘colla’ in Barcelona and in Catalunya.

Counting all sections, we are over 120 people. The adult section of the ‘colla’ has a steady participation in 13 correfocs every year at least, plus the ones that Malsons and Atzeries do on their own or to the ones to which the whole ‘colla’ is invited. We won third position in the 1st Catalan Fire contest in 2018. This is a contest where different Catalan ‘colles’ come and participate by doing two big fire performances, and they are evaluated according to different criteria set by a jury.

Farrófoc is a much smaller group, having only the adult section with their own drummers. They have a Lucifer and a She-devil figure with special maces called ‘ceptrots’. It was formed in 2017 by a group of friends, most being parents from the same primary school. It started with a few correfocs and is slowly widening its scope beyond the Farró area into other areas of Barcelona and cities in Catalunya (Figs. 2 and 3).

Each ‘colla’ has some elements that relate to their area or neighborhood (Colombo et al. 2021). For example, Farrófoc’s logo is an Owl because it refers to a legend of a big Owl that used to live in Putxet Park (the park in this neighborhood) and would hunt at night and be seen flying over certain areas of Farró. One of its ‘ceptrots’ (special ‘maça’) is, therefore, an owl (Fig. 3) as is their logo (Fig. 4).

A ‘correfoc’ will follow a pre-defined route through the streets of Barcelona or any village. It is a musical, pyrotechnic and dance event. It consists of devils jumping and dancing around the streets with spectators running into the space the devils are dancing and making playful human barricades to stop the devils from advancing in the route. Devils can also be lifted in the air by spectators. The interaction tends to be playful, and in the last few years, there has been an increasing number of children coming to ‘correfocs’ (with the appropriate clothing and protection) who also want to play under the fire sparks that the pyrotechnics emit. Devils will normally dance while advancing, making a single or a double line (either one or two devils at a time) while the firecracker at the end of their ‘maça’ is still going, then they stop, return to the beginning, get another one and restart. At certain intersections in the route, all devils gather to burn the firecrackers at the same time, this is called a “joint burn”. They form a circle, and all light their firecrackers simultaneously, then taking two steps backwards and creating a ball of fire, all jumping together in a circle until the last firecracker explodes. We can see that a ‘correfoc’ has a noticeable amount of “back and forth” and, as such, does not follow linearly the predetermined route. Therefore, a single ‘correfoc’ with a 2 km route can take over an hour for a single ‘colla’ to go from start to finish. In addition, whenever there is a Correfoc, there are several ‘colles’ participating. So, there is a queue of ‘colles’, each burning separately during the route and then having a communal, massive burn at the end of the route, when all ‘colles’ have arrived.

This brief explanation of the functioning of a ‘correfoc’ is to illustrate the amount of time devils spend in the many ‘correfocs’ they partake in per year, and as such, the number of decibels their ears are exposed to several times a year for extended periods of time.





**Fig. 2 Lucifer and She-Devil from Farrofo 'Colla'.** Source: Made by the author. This figure is covered by the Creative Commons Attribution 4.0 International License.

## Pyrotechnics

The firecrackers and fireworks we use in correfocs are done in four main factories in Catalunya, Catalana, Estalella, Garcia and Igual. I have interviewed two of them to get a deeper understanding of the construction of the main fireworks we use.

The Malsons use specific pyrotechnic artifacts approved for minors. Their pyrotechnia does not have a thunder and are much quieter than adult pyrotechnia. I will explain the different types of pyrotechnic artifacts at the end of this section.

Atzeries uses larger pyrotechnia, almost no single 'carretillas' and mostly 'sortidors'. In this sense, Atzeries's firepower is stronger and thus louder than the devil's habitual pyrotechnia and lasts for longer (this is due to the fact it has more gunpowder combined with a longer tube, so it takes longer for it to burn). It also has a louder thunder.

We mainly use four kinds of pyrotechnic artifacts, 'carretillas', 'sortidors', 'bengales', and 'patums'. 'Carretillas' are the simplest of the four; a 'carretilla' is a horizontal cardboard tube with a wick on one end and a pointy cardboard end (where the 'thunder'—the part that makes the loud bang at the end is). The tube itself is filled with a specific mix of gunpowder with other compounds (the exact recipe is trademarked), we can see the design in Fig. 5.

Other kinds of 'carretillas' widely used are 'xiuladores' also called 'roncadores'. Like 'carretillas' in size but 'xiuladores' emit a whistling sound from ignition to thunder explosion ('xiuladores' means the whistlers). Both have a thunder like 'carretillas'. The 'sortidors' are thicker sorts of 'carretillas' that last longer and have a louder thunder. The color of the sparks may vary, but that does not vary the sound it makes. The thunder is built separately from the composition that gives pyrotechnia's spark their color. 'Bengales' have no thunder, they are what is commonly referred to as flares. 'Patums' are a separate pyrotechnic family, longer and thinner than 'carretillas', they have a low combustion speed and make a rustling sound that is much quieter than any other pyrotechnic artifact, the visual sensation is that of a slow rain of very thin orange sparks (Fig. 6).

Then the 'volcanets' are artifacts to be put vertically on the 'maça', the gunpowder composition can emit a variety of colors (and be multicolored) and at the end, the thunder is a loud bang that sends small, colored burning "small balls" vertically projected into the air (Fig. 7) (DOGC, 2016).

Pyrotechnic artifacts have three main parts, the detonating matter (what is used to make the thunder and open the pyrotechnic artifact), the pyrotechnic matter (what is used to produce nondetonating effects, the colors, the sparks), and the inert matter (cardboard, capsule, any other element) (DOGC, 2016). The volume of each pyrotechnic artifact is tested individually and depends on three aspects. First, the bigger the pyrotechnic artifact is, the louder it will be. Then, it depends on the kind of thunder used, it can be louder if it has more detonating matter. The last element is the pyrotechnic matter used in the main tube; depending on its composition (manufacturers' do not share the detail of the compositions) it will make the pyrotechnic artifact louder (for example, 'xiuladores') or burn for longer (for example, 'patums') Pyrotechnic artifacts are classified by type, there are four types. The classification depends on the amount of gunpowder and the type of thunder (Table 1).

According to the Catalan regulation of fire, called ITC-18, categories are as follows:

"Category F1: Pyrotechnic artifacts with very low dangerousness and an insignificant sonic level destined to be used in delimited areas, including the pyrotechnical artifacts destined for residential indoor use.

Category F2: Pyrotechnic artifacts with a low level of dangerousness and low sonic levels destined to be used in open-air areas in delimited areas.

Category F3: Pyrotechnic artifacts with a medium level of dangerousness destined to be used in vast open-air areas, with a sonic level that is not harmful to human health.

Category F4: Pyrotechnic artifacts with a high level of dangerousness exclusively destined to be used by professionals and with a sonic level that is not harmful to human health" (DOGC, 2016, pp. 2–3). Regulations are clear on not modifying the pyrotechnic artifact in any way.

Devil 'colles' are allowed to use F1, F2, F3.

The ages are also regulated according to their dangerousness. F1 is to be used by 12+ year olds, F2 by 16+ year olds, F3 by 18+ year olds and T1 and P1 by 18+ year olds. F1 and F2 ages may be reduced, upon a justified previous request to 8- and 10-year-old, respectively, so that children devils can use them. However, their



**Fig. 3 Detail of the Owl 'Ceptrot'.** Source: Made by the author. These figures are covered by the Creative Commons Attribution 4.0 International License.



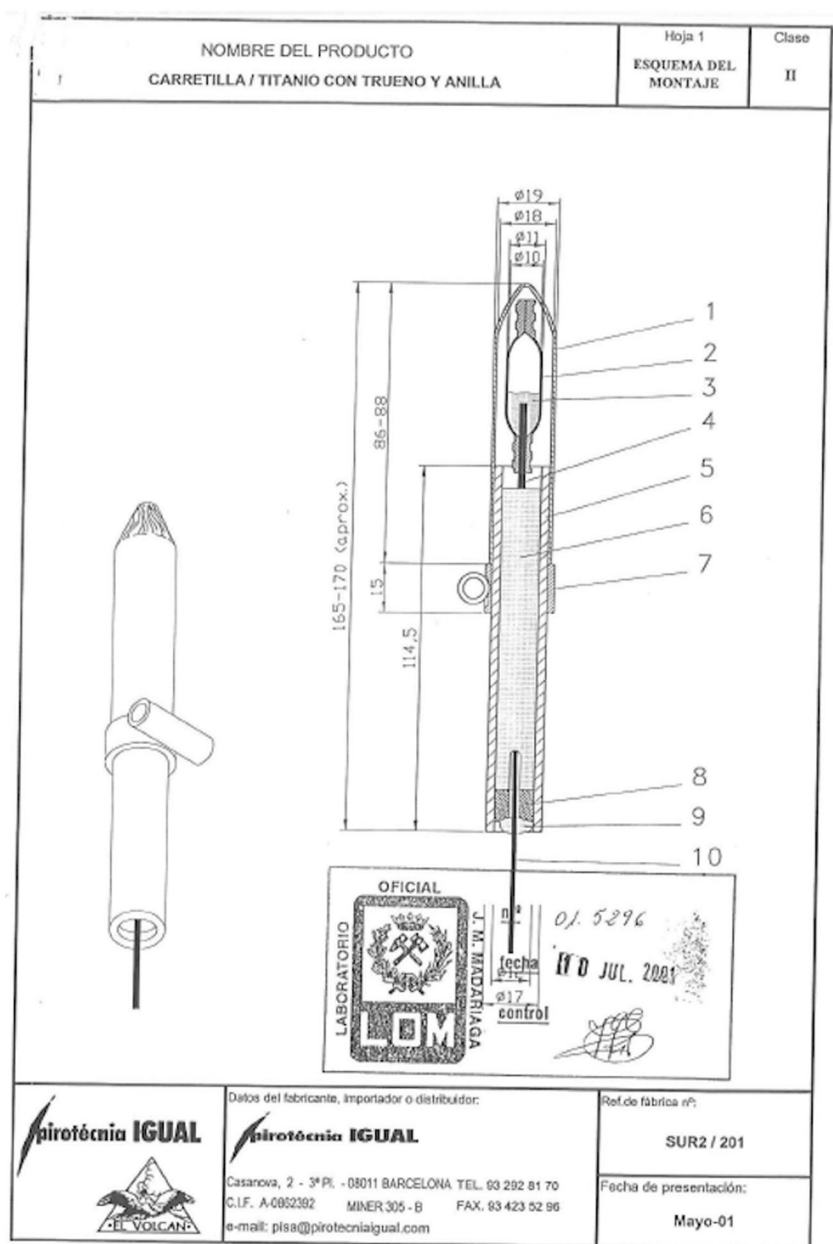
**Fig. 4 Farrófo's logo is imprinted on the fireproof clothing.** Source: Made by the author. This figure is covered by the Creative Commons Attribution 4.0 International License.

use must always be supervised by the legal guardian, parent, or tutor (DOGC, 2016).

ICT-18 regulations also state the ways in which pyrotechnical artifacts must be transported, manipulated, and stored. The

regulation does state the clothing needed to use the pyrotechnic artifact, it is fireproofed clothing and hats, gloves and glasses. When the regulation is stating "a sonic level that is not harmful for human health" it refers to the statutory Health and Safety





**Fig. 5 Diagram of the structure of a 'carretilla'.** Source: DOGC (2016). F1.1 Not subject to copyright.

regulations, which determine 120 dB as the threshold of pain for human hearing. The issue with this is that it is measured individually, one pyrotechnic artifact at a time. There is no mention of sonic protection in the regulation.

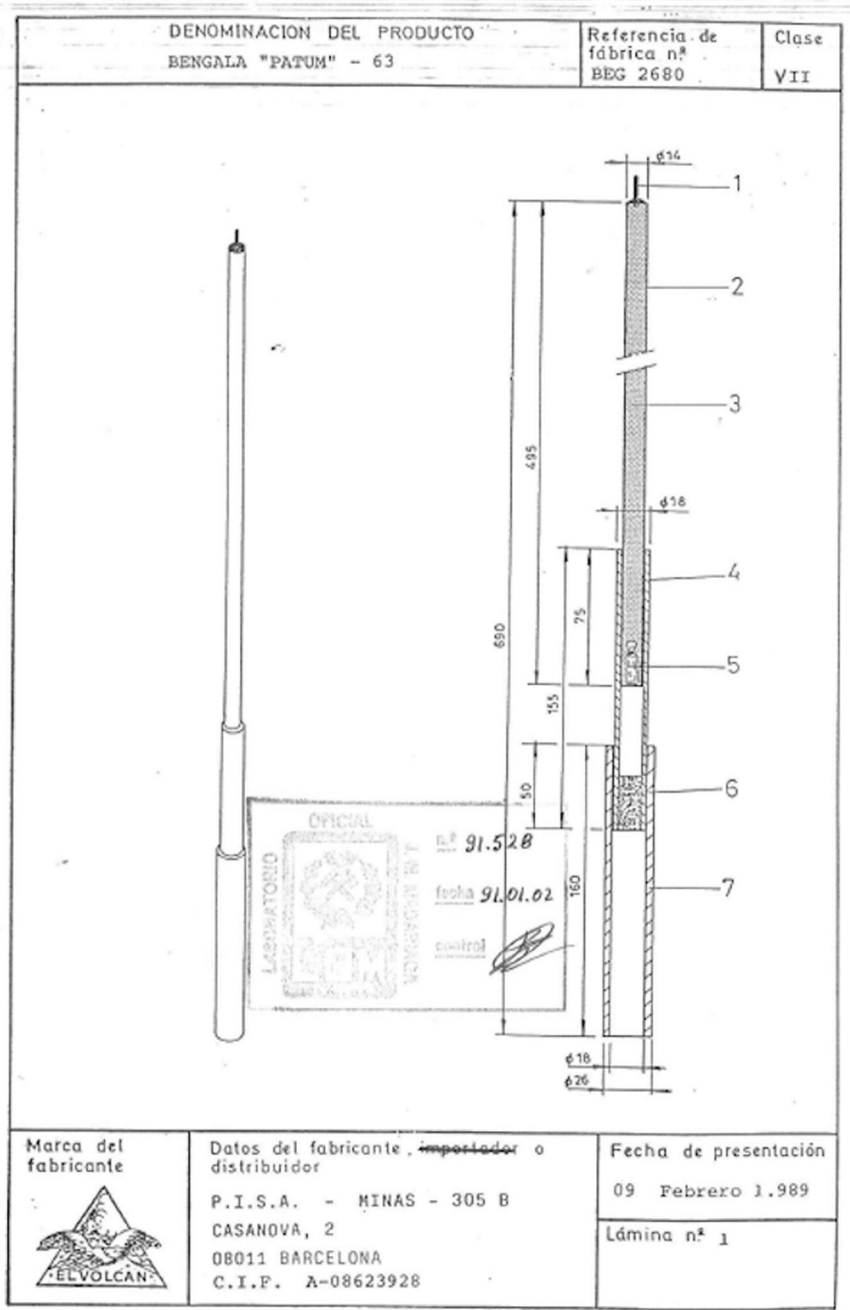
### Methodology

This research is methodological bricolage brought on by the Covid-19 pandemic (Kusenbach, 2003; Murthy, 2008; Yardley, 2008). As mentioned earlier, this article builds on a previous article exploring nociception and a sense of belonging during a 'correfoc' (Berrens, 2022). For this article, the methodology consisted of a new online survey (referred to as a second survey) distributed to devils from three 'colles' in Gracia across different sections. The survey had a quantitative section with multiple-choice questions and a qualitative one with open questions. The second part of the methodology is qualitative, with focus groups and semi-structured interviews. On the one hand, there were

online surveys; then there were semi-structured interviews with several devils of the 'colles' and pyrotechnic artifacts' manufacturers.

The survey was distributed online to the same devil's groups research had been done, colles in Barcelona (Berrens, 2022). These groups have different sections, and the first survey was passed indiscriminately on age or role within the group to all. The second survey was only passed to "burners" (devils that burn in a 'correfoc', not drummers) in all sections. There were 64 replies to the first survey and there are 39 replies to date to the second phase survey. In the results we will focus on the results of the second survey. When considering that there are a lot less devils than drummers in any given 'colla', this is still a significant sample in the frame of this research.

The surveys were used to guide the interviews. There were 12 follow-up interviews for survey participants, these were done to devils who were interested in having a follow-up interview through an open call for devils to be interviewed. The survey took



**Fig. 6** Diagram of the structure of a 'Patum'. Source: DOGC (2016). F1.1. Not subject to copyright.

place during 2022 and the interviews during the same year. There is an ongoing autoethnography during 2022 fire season that has enabled the grounded theory analysis to be further informed (Pertti et al. 2008).

There were also two initial interviews done to pyrotechnics manufacturers in Spain, followed by two more in depth interviews to the same main pyrotechnics manufacturers. This was expected to gather precise data on the manufacturing of pyrotechnics to see how is sound calibrated in a pyrotechnic artifact and examine health impacts in manufacturer's workers too.

The quantitative questions results are presented as percentages. The survey's open questions and interviews have been analyzed using thematic analysis and grounded theory seeking to understand the relationship between place, a 'correfoc' and the relationship between aural diversity, community engagement and belonging to a 'colla' as sound has a strong

relationship to feeling (Liu and Kang, 2016, p. 32). I have based this analysis on Wetherell to "allow for a different view of 'constituted identities'" (original emphasis in the text, Wetherell, 1998, p. 14). For the manufacturers' interviews, we were seeking to understand the way the artifacts are produced and the testing they undergo, options for quieter products and hearing diversity.

**Findings**

From the survey, we can see that 82,1% of the answers to the survey came from devils aged 18 or over (51.3% of the respondents are between 31 and 50 years old, and the same 17.9% are 51-70 and 12,8% are 18-30) and then 17.9% are 10-17. Then 66.7% are from La Vella de Gràcia, 20.5% from other 'colles', and 12.8% from Malèfica del Coll. 66.7% of the respondents are in the

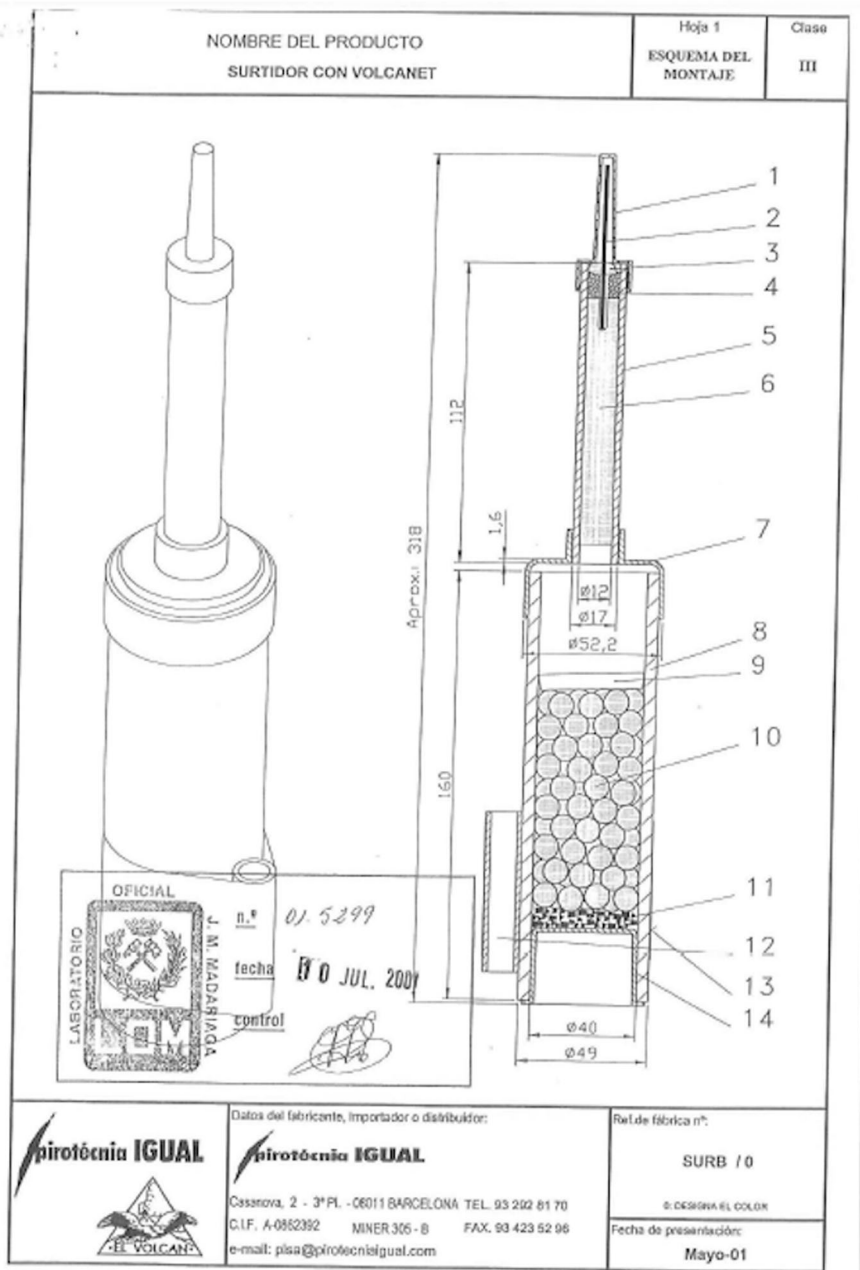


Fig. 7 Diagram of the structure of a 'Volcanet'. Source: DOGC (2016). F1.1. Not subject to copyright.

Table 1 Pyrotechnic artifacts and their characteristics.						
Type of pyrotechnic artifact	Sub-type of artifact	Characteristics				
		Position	Final thunder	Sound	Special characteristics	
Carretilla	Xiuladores/Roncadores	Horizontal	Yes	Whistling sound/Bass like snoring sound	Possibility of different colors (each artifact is one color only)	
	Carretilla	Horizontal	Yes	Sound of sparks cracking	Possibility of different colors (each artifact is one color only)	
Sortidors	Sortidors/Francesos	Vertical	Yes	Sound of sparks cracking	Possibility of different colors (each artifact is one color only)	
	Volcanet	Vertical	Yes	Sound of sparks cracking	Variety of colors in a same artifact. Thunder projects small balls into the air.	
Bengales	Bengales	n/a	No	Quiet sound of sparks	Red or white	
Patums	Patums	Vertical	No	Quiet sound of sparks	Orange	

Source: Elaborated by the author.



adult section, 28.2% in the children's and 12.8% in the Beasts' section of their respective 'colles'.

We observe that 61.5% of devils had been in a 'colla' for over 5 years, if we take into consideration that 64.1% of the respondents participate in over 6 correfocs per year, and an extra 28.2% participate in over 10 'correfocs' per year, we can gather the frequency of exposure to a very loud environment for a prolonged period. In addition, 66.7% of survey respondents affirm not to use ear protection. Some of the reasons given for this were feeling "too isolated", or being "used to the sound", for some having an extra piece of gear was "uncomfortable", for others priority is given to security in hearing instructions over self-preservation and finally a group of devils said that they wanted to hear the fireworks because they liked the soundscape a 'correfoc' creates. From all respondents, 33.3% wear earplugs, mostly wear foam earplugs (85%) with the remaining 13% wearing plastic ones and one of them wears bespoke plastic earplugs (made specially for 'correfocs').

Moreover, we can observe that a third of surveyed devils said that 'correfocs' had had an impact on their hearing ability, within this group, identifying hearing loss (25.6%) as the main impact, the rest having several variations of temporary aural diversity straight after a correfoc for the remaining devils.

There is a 38.5% of devils that has acquired aural diversity. From all respondents, 15.4% of devils were getting medical treatment for their aural diversity. Of those surveyed, a 28.2% thought this acquired aural diversity was, in fact, due to the exposition to correfocs' sound.

In addition, 15.4% of devils had a negative experience of this aural diversity, while 28% said it did not bother them. Over a third (38.5%) of all devils surveyed agreed with the statement that ending up with hearing issues is part of being a devil. Upon asking what their lived experience of this altered aural perception, 15.4% said it was a negative experience, while 28.2% said it made no difference to them. Finally, devils were asked what they think about changes in hearing, 17.9% stated it is normal for it to happen, 5.1% said it will happen to all the devils, 5.1% said it will only happen to the devils that are really invested, a further 51.3% of devils thought that acquiring aural diversity was going to happen to devils who do not wear ear protection.

There was a draw when asking if the devils were relating this aural change to their belonging to the group, 20.5% agreed, while the other 20.5% disagreed (the remaining 59% said it did not apply to them), 5.1% of devils stated that having some sort of aural diversity<sup>2</sup> does impact on their sense of belonging to a 'colla'.

Finally, though gender was not a focus for this paper, once examined the results, we can see that there were 17 female respondents and 22 male respondents. We can see there was 56.5% of male respondents in the sample. From the female respondents, 4 used ear protection (23.5%), 13 did not (76.5%). While for the male respondents, 9 used ear protection (40.1%) and 13 did not (59.9%). When asked if 'correfocs' had had an impact on their hearing ability, 3 females said they had (17.6%) while 14 said it had not (82.4%) and 10 male respondents said it had (45%) and the remaining 12 (55%) said it didn't. When asked if they draw a relationship between their participation in 'correfocs' and their aural diversity, 3 females answered affirmatively (17.6%) and 14 negatively (82.4%), while 8 males (36.6%) answered affirmatively and 14 (63.4%) negatively. We can argue more males had issues with hearing because of 'correfocs' and, as such, used more protection and connected aural diversity with 'correfocs'. However, the interviews did not shed light on the why. Hence, this data is an interesting point from which to do further research having gender at the core of the project.

However, the result from the interviews is quite different. The selection of interviewed participants was not done according to their survey questions, an open call for an interview was issued amongst the survey respondents. We gather that the devils that came forward for an interview were interested in the research and the sonic impact is something they likely think about.

From those interviewed, 69% did use ear protection and 90% had noticed an aural change between their hearing before and after the 'correfoc'. It could be either temporary or a change that has, for example, prompted them to decide to start using protection. When talking about whether devils would acquire diverse aural diversity because of 'correfocs', 95% of interviewed people agreed (with the difference to the 51.3% of surveyed individuals). However, they saw personal protection as a solution instead of less volume for pyrotechnics.

Along these lines, 90% of interviewed devils would not like to have silent 'correfocs' or the pyrotechnics made less loud.

The findings also show that 38.5% of surveyed devils, 70% of interviewed devils and 100% of interviewed pyrotechnics manufacturers have suffered from some kind of aural diversity either after a 'correfoc' or after testing pyrotechnics.

From the interviews with manufacturers, we gather the louder part of a pyrotechnic artifact is the thunder. It has a double objective; on the one hand, it wants to contain the gases emitting from the burning of the compound in the main chamber, and it has its own compound that makes a loud bang when it explodes. The intensity and sonic level of the thunder depend on the compound in this small capsule. At an 8 m distance, a 'carretilla's' thunder will be between 96 and 101 dB. Children's pyrotechnic's thunder will range between 70 and 83 dB. Manufacturer's will do random tests in each batch produced to see if the artifacts comply with the regulations (in this case, it is the standard health and safety regulations that state that the maximum permitted sonic level is 120 dB, very close to the human threshold for pain).

Another manufacturer states that the sound in the thunder is very tightly controlled because it can lead to strong hearing injuries. If, at any control, a thunder is louder than what is it supposed to be, the whole batch is thrown away.

Moreover, 100% of the manufacturers interviewed stated that the environment in which the sonic levels are measured is nowhere near the reality of where the pyrotechnic artifacts are used, that the reverberation, the area's layout (if there are many or few trees, if it's an open space, if it's a narrow street with tall buildings, if it is a wide street, etc.) or also if more than one pyrotechnic artifact is used at the same time will have a significant impact on the overall sonic levels.

## Discussion

In this section, we will discuss the results presented above. To better inform this discussion I will also draw on the main findings from the first survey reviewed previously (Berrens, 2022). As seen earlier in this paper, more than half of the surveyed devils are 31–50 years old and that 61.5% of them have been in a 'colla' for over 5 years. In addition, 64.1% participate in over 6 'correfocs' per year, with 28.8% going to more than 10 'correfocs' per year.

This means that their hearing has been consistently exposed to 'correfocs' for over 5 years with a noticeable frequency. We have also seen that 66.7% of individuals surveyed do not use ear protection. All together we can notice there is frequent exposure to loud sound without an appropriate protection, or any protection at all, for two-thirds of devils. It is striking to see there is a detailed regulation on pyrotechnic artifacts but no regulation on ear protection. In the sense that, falling inside the scope of health and safety, one would expect that there would be a regulation for ear protection (DOGC, 2016).

From the interviews, we can see that upon agreeing to be interviewed, aural diversity was something that these devils were, at least, thinking about. Hence, they may have a higher sensibility to this topic or have had some aural diversity previously. As such, we gather that the devils using ear protection do so because they had problems with their hearing (may that be temporary or permanent). This led them to prefer to use protection and deal with having to listen more carefully to the Fire Chief's instructions than to carry on damaging their hearing. Interviewed devils noted that once you have had some aural diversity, the possibility of it becoming something permanent becomes more palpable. Some devils stated the reason they do not want to wear (and don't) ear protection is that otherwise they do not have the same connection with space, and their making of place is different, pain or hearing damage is accepted in exchange for hearing clearly the Fire Chief and being part of a spectacle that is immersive sensorially (Berrens, 2019, 2022; Imrie, 1996; Schwartz, 2003, 2011). This connection with space is part of the making of space, which, in turn, and particularly during a correfoc, can be understood as a place-event, as Pink describes happening for bullfighters (Pink, 2011, p. 354):

Yet the skill of the performer and the ways in which her or his embodied knowing informs and guides actual practices as they are performed are contingent on their being part of a complex and shifting ecology, where intensities of some interrelationships can be understood through the concept of hybrids and which I suggest is best understood as a place-event.

In addition, when devils speak about their connection to space, they are also talking about emplacement. We cannot separate the making of place from the body as it is an intrinsically corporeal activity (Ingold, 2000), yet it is also dependent on the relationships that configure space and place (Agnew, 2011; Massey, 2005), hence the making of place during a correfoc for devils is part of the event itself, generating a place that is limited to the event itself. Therefore, there is a perception of change in the experience of a correfoc when they are wearing ear protection since it varies their bodily relation to space as well as their cognitive relation to the event (hearing well the Fire Chief's orders).

Moreover, at no point have they considered ceasing to partake in the activities that are either actively damaging or contributing to further damage to their hearing abilities. As explained earlier, fire is deeply embedded in Catalan popular culture (Palomar, 2013; Massana, 2015) and there is a strong sense of belonging to the 'colla', as seen with the 39% of surveyed devils having been in the 'colla' over 10 years. There is a sense of belonging to the 'colla' combined with a pride in undertaking the liturgy typical of 'correfocs'. Historically these have been loud, hence it is assumed that the loudness is intrinsically part of the 'correfoc'.

As seen, over a third of surveyed devils and over 80% of interviewed devils state that having hearing diversity is a consequence of being a devil. The interviewed devils traced a fine line between the need to hear the Fire Chief's instructions and their hearing, there was discussion on which would be the best kind of earplugs to prevent hearing damage and still enjoy and feel they partake in the 'correfoc', this enjoyment also came from a sense of safety once the visual anchor in our occularcentric society is no longer reliable because of the amount of smoke there is (Berrens, 2015; Latour, 2004).

As seen above, the manufacturers test each pyrotechnic artifact individually, making sure its overall sonority does not reach above what it is intended to be and, in no case, goes above 120 dB. This is not an accurate sonic test of the real conditions that are in a 'correfoc' at any given time, it can reach 175 dB depending on

the composition and layout of the space in which it takes place, the pyrotechnic artifacts used and the number of 'colles' and devils in each 'colla' (Berrens, 2022). In response to the sonic intensity generated by 'correfocs', there is a movement in Catalunya for 'correfocs' to lower their volume because of the impact they can have on wildlife and domestic animals. Dogs are known not to like the thunder of pyrotechnic artifacts and get very scared. On the other hand, for four of the interviewees, 'correfocs' need to be kept *traditional*. By this, they are referring to not changing the pyrotechnic artifacts of the ways of burning. They want tradition to be passed on from generation to generation and, therefore, are not inclined to willingly adapt to lower pyrotechnic artifacts' volume. This divergence in opinion as to what a 'correfoc' should be and how it should evolve falls within the social debate of tradition and purity versus innovation and will be an interesting area to further in following research projects (Gates et al. 2019; Poole 2018; Shamoun-Baranes et al. 2011). The movement defending pets against loud sonic inputs is also asking for silent 'correfocs' and pyrotechnic spectacles. As one of the interviewees mentioned, in the Arab Emirates, they have done some spectacular silent displays of drones with lights that, to some extent, mimic the aesthetics of a pyrotechnical celebration such as New Year's fireworks. These spectacles are done with many small drones that emit lights in a certain rhythm while they fly in the air with a pre-designed pattern. Albeit being an interesting luminous spectacle, this does not replace something like New Year's celebrations in terms of fire spectacle. Many devils are opposed to the pyrotechnic artifacts becoming quieter, they consider it would not change the 'correfoc', it would not even be one but something completely different. For them, the 'correfoc' is a multi-sensory experience and sound cannot be disassociated from it.

There have also started to emerge pyrotechnia manufacturers that make less loud and more eco-conscious artifacts, with recycled cardboard, low grammage for thunders and a maximum volume of 97 dB which is what the factory technicians consider the volume of a conversation outdoors during daytime in a city (Arqué, 2023).

## Conclusions

In the discussion, we have analyzed how devils do oversee their personal health through a constant exposition of very loud pyrotechnic artifacts. This is due to the strong sense of commitment that comes from being part of a 'colla', many devils stay in a 'colla' for decades, being part of the 'colla' carries a sense of duty as well as pride (Berrens, 2022). This manifests with a strong sense of belonging ascribed to a 'colla' (Colombo et al. 2021; Crespi i Vallbona, 2003) and it influences devils to oversee their personal health to either better listen to the Fire Chief or feel a connection with the 'correfoc' itself and the temporary sense of place generated (Jones, 2014). The disconnection that earplugs can produce is what some devils were weary of. Belonging is a key element in the acceptance that some sort of aural diversity may result from this repetitive exposition of very loud pyrotechnia. However, even when some devils clearly traced a connection between 'correfocs' and their hearing diversity, which for the interviewed devils was traced by 90%, there was no intention to stop partaking in these activities. Devils appear to be ready to sacrifice part of their health in order to keep partaking and producing 'correfocs'. Through the results analyzed, we conclude that for many devils, it appears as if being part of a 'colla' may mean acquiring some hearing diversity, and they are ready to accept it (Berrens, 2022). Aural diversity becomes a badge of belonging (Berrens, 2022) strengthening the sense of belonging, somehow becoming an aspect deriving from the 'correfoc' events'

cultural identity “conferring cohesion, integration and belonging to a communities’ ties in a concrete locus” (Crespi i Vallbona, 2003, p. 73). We conclude the sense of belonging is to the colla with a very strong bond (Colombo et al. 2021) but also to the popular culture community in a specific territory.

Regarding the manufacturers’ interviews, the conclusions are two-fold. On the one hand, testing the pyrotechnia individually does not, at any point, give a sonic measure that is close to the reality of a ‘correfoc’. Therefore, the threshold for pain (120 dB), which is the limit for thunders in pyrotechnia, will be heavily exceeded during a correfoc. On the other hand, there is no regulation specific for ‘correfocs’ in Catalunya and that is somehow puzzling, not even in Barcelona (a city that has a specific regulation for sound emissions inside an Eixample ‘island’ (Ajuntament de Barcelona, 2017)). We can conclude that official regulations regarding sonic emissions in ‘correfocs’ are lacking and measuring tools for pyrotechnia are not accurate with regards to their final use.

We also conclude with the exposition that there is a growing social consciousness about the volumes in ‘correfocs’ and pyrotechnic artifacts. It is interesting to see alternatives emerging both in terms of lessening the volume and about making sound-free spectacles.

The presences of silent or musical ‘light’ displays made with drones is becoming more frequent and, in future research, it would be interesting to analyze the shift towards quieter festivities and the drones’ displays.

Nevertheless, the future of ‘correfocs’ is unlikely to be silent; there is too much resistance from people already in this tradition, and it would entail a 180° turn on a key component of Catalan popular culture. However, a move towards more sustainable (recycled) and conscious (with smaller thunders) pyrotechnic artifacts is already underway. Whether this will change this tradition or generate a “silent spin-off” from ‘correfocs’ is yet to be determined<sup>3</sup>.

## Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to working with minors but are available from the corresponding author on reasonable request. They are stored according to the University of Barcelona guidelines for data storage.

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## Notes

- 1 In Catalunya, pyrotechnic artifacts and fireworks are categorized in different groups according to the grams of gunpowder they contain and the decibels of their thunder (the exploding part). The regulation divides the artifacts into four main categories, F1–F4 ranging from less dangerous and less loud to high levels of dangerousness and a sonic level at the limit of 120 dB. For more information, see ref. DOGC (2016) FPC1.1.
- 2 Aural diversity is the concept that everybody hears differently. This comes from sensorineural, conductive, technological, and auditory variations that can be acquired through life (amongst others). There is a common misconception that everybody hears the same, yet this is mistaken (Hugill, 2022). We all hear differently and the divergence in listening is mediated, for example, by socialization (Nancy, 2007). In this research, aural diversity is the variation in hearing that can be acquired through participating in correfocs, but it is not necessarily a negative experience.
- 3 This article has been revised during the last trimester of 2024. Barcelona’s patron festivities (La Mercè) are at the end of September. The 2024 edition is the first edition to have three fire castles (pyrotechnic exhibitions with fireworks in the sky, like New Year’s fireworks in the UK or the US) on three different days but also two ‘lights’ exhibitions done with drones, silent and also in the sky. There is a shift towards, at first, silent light exhibitions having a space they did not have beforehand (<https://www.barcelona.cat/lamerce>).

- 4 European Code of Conduct for Research Integrity of All European Academies (ALLEA) <https://allea.org/wp-content/uploads/2017/05/ALLEA-European-Code-of-Conduct-for-Research-Integrity-2017.pdf>
- 5 The UB ethics code can be found here: <https://diposit.ub.edu/dspace/handle/2445/142043>
- 6 University of Barcelona Research Data Management Policy <https://diposit.ub.edu/dspace/handle/2445/142043>

## References

- Agnew J (2011) Space and place. In: Agnew J, Livingstone D (eds). Handbook of geographical knowledge. Sage, London
- Ajuntament de Barcelona (2017) Ordenança Medi Ambiental Barcelona. Ajuntament de Barcelona
- Ariño A, García P (2012) Introducció. Mètode: Rev Difus Investig 75:50–51
- Berrens K (2019) Sonic and tactile bodies: sound, haptic space and accessibility. In: Doughty K, Duffy M, Harada T (eds) Sounding places: more-than-representational geographies of sound and music. Edward Elgar Publishing, Cheltenham
- Berrens K (2022) Fire, drums and the making of place during a Correfoc. In: Hugill A, Drever J (eds) Aural diversity. Routledge, London
- Berrens K (2015) Ensounded bodies: making place in London’s East End. PhD dissertation. Universitat Oberta de Barcelona <https://openaccess.uoc.edu/handle/10609/44881>
- Bertran J (2009) L’evolució del foc festiu als països Catalans en el context mediterrani. Caramella 20:4–12
- Colombo A et al. (2021) Playing with fire collectively: contemporary cultural rites as devisers and outcomes of community networks. Event Manag 25:57–68
- Colombo A, Cantó-Milà N (2019) Branding authenticity, perceptions of La Patum de Berga, a complex place marketing event in Catalonia, Spain. In: Cudny W (ed) Urban events, place branding and promotion, place event marketing. Routledge Taylor & Francis
- Crespi i Vallbona M (2003) L’activitat festiva popular en l’era de la mudialització: el cas de Catalunya. Tesi doctoral. Dipòsit a la UB, facultat de Sociologia
- DOGC, (2016) FPC1.1 Regulació i normativa de materials pirotècnics. Generalitat de Catalunya, Barcelona. <https://dogc.gencat.cat/es/inici/>. Accessed 22 Jun 2023
- Fericglà JM (ed) (1990) Els ritus del foc a l’Antiga Corona d’Aragó. Aragó, Barcelona
- Gates MC, Zito S, Walker JK, Dale AR (2019) Owner perceptions and management of the adverse behavioural effects of fireworks on companion animals: an update. NZ Vet J 67(6):323–328
- Imrie R (1996) Disability and the city: international perspectives. Sage, London
- Ingold T (2000) The perception of the environment. Routledge, London
- Jones H (2014) Stories of cosmopolitan belonging: emotion and location. Routledge, London
- Kusenbach M (2003) Street phenomenology the go-along as ethnographic research tool. Ethnography 4(3):455–485
- Latour B (2004) How to talk about the body? The normative dimension of science studies. Body Soc 10(2–3):205–229
- Liu F, Kang J (2016) A grounded theory approach to the subjective understanding of urban soundscape in Sheffield. Cities 50:28–39
- Massana H (2015) Mercè 79, Els orígens del Correfoc. Emboscall, Barcelona
- Massey D (2005) For space. Sage, London
- Murthy D (2008) Digital ethnography: an examination of the use of new technologies for social research. Sociology 4(5):837–855
- Nancy J-L (2007) On listening. Fordham University Press Collection, New York
- Palomar S (2013) El marc festiu del foc a Catalunya. La pirotècnia i els seus usos a la festa. [www.diables.cat/legislació](http://www.diables.cat/legislació). Accessed 22 Jun 2023
- Perti A, Brannen J, Bickman L (2008) The sage handbook of social research methods. Sage, London
- Pink S (2011) From embodiment to emplacement: re-thinking competing bodies, senses and spatialities. Sport Educ Soc 16(3):343–355
- Poole S (2018) An exploration of the tension between tradition and innovation. In: Martin L, Wilson N (eds) The Palgrave handbook of creativity at work. Palgrave Macmillan, Cham
- Schwartz H (2011) Making noise—from babel to the big bang and beyond. MIT Press, Cambridge, MA
- Schwartz H (2003) The indefensible ear: a history. In: Bull M, Back L (eds) The auditory culture reader. Berg, Oxford
- Shamoun-Baranes J et al. (2011) Birds flee en masse from New Year’s Eve fireworks. Behav Ecol 22(6):1173–1177
- Vilarrúbias D (2018) El foc del seguici, Monogràfic: Som cultura popular. Canemàs, Barcelona
- Wetherell M (1998) Positioning and interpretative repertoires: conversation analysis and post-structuralism in dialogue. Discourse Soc 9(3):387–412
- Yardley A (2008) Piecing together—a methodological bricolage, forum qualitative sozialforschung/forum. Qual Soc Res 9(2):n.p



## Websites

Arqué J (2023) Petards menys sorollosos per a revetlles familiars i que no espantin les mascotes. <https://www.ccma.cat/324/petards-menys-sorollosos-per-a-revetlles-familiars-i-que-no-espantin-les-mascotes/noticia/3236315/>. Accessed 22 Jun 2023

Barcelona cultura popular, festes i tradicions. <https://www.barcelona.cat/culturapopular/es/fiestas-y-tradiciones/personajes-y-elementos-festivos/correfoc>. Accessed 22 Jun 2023

Diablers de Sitges, història. <https://diablersdesitges.cat/historia>. Accessed 22 Jun 2023

Hugill A (2022) Aural diversity infographic. <http://auraldiversity.org/infographic.html>. Accessed 18 Nov 2024

La Mercè website. <https://www.barcelona.cat/lamerce>. Accessed 10 Oct 2024

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## Author contributions

This paper has one sole author, and therefore all work has been undertaken by her.

## Competing interests

The author declares no competing interests.

## Ethical approval

This study was performed in line with the University of Barcelona (UB) Code of good practices approved in 2010. It follows the European Code of Conduct for Research Integrity<sup>4</sup>, developed by All European Academies (ALLEA), the European Federation of Academies of Sciences and Humanities. It also follows the principles of the Declaration of Helsinki. The study spanned from 2019 to 2023 and followed the Ethical Guidelines approved by the University of Barcelona (UB)<sup>5</sup>. The research followed the conducts for ethical research with participants and minors, data anonymisation, and had a data management plan according to UB guidelines<sup>6</sup>.

## Informed consent

Informed consent of all participants (surveyed and interviewed) was obtained before they completed the survey in writing and when working with minors, informed consent was given by their legal guardians or parents in writing before starting the survey (during the period February–September 2022). No minors were interviewed. The scope of the consent covered taking part in the research, the process of assuring anonymity and that data coming from the research would be published and/or exposed at conferences, journals, or book chapters. Participants were fully informed their anonymity was assured through the research and in any subsequent publications.

## Additional information

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