

Chapter 182

Forensic Science or Forensic Sciences? Conceptual analysis

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ABSTRACT

Science and justice need to interact to solve different situations. This interaction, however, needs to occur efficiently to avoid generating even more doubts. Scientific evaluation in the legal context must be understood and achieve its purpose. For this, much has been discussed about the nature and purpose of forensic scientific assessment. In this work, the aim was to evaluate what forensic science is and what is the conceptual alignment of this area of knowledge concerning national and international scenarios. We performed a bibliographic review on the subject to understand the fundamental aspects of this theme. Conceptual studies on forensic science are practically non-existent in the national literature. Forensic science was contextualized in its multi, inter, and transdisciplinary aspects. The quantitative results of the bibliographic review showed the urgent need for developing the theme in the national scenario and its alignment with the world understanding. Historical aspects of the development of forensic science were used in the discussion about the conceptualization of the term. Yet, internationally there are constant efforts to define the purpose and scope of forensic science. The Sydney Declaration was recently launched as a guiding document. We concluded that discussion about the concept of forensic science must be constant to improve it at the national level and to align it with international thinking. Hopefully, this work will encourage the discussion of the topic, strengthening the development of forensic science and reinforcing its importance for the administration of justice.

Keywords: Forensic science; Forensic sciences; Forensic intelligence; Interdisciplinarity.

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1 INTRODUCTION

"Science and everyday life cannot and should not be separated"
Rosalind Franklin

Science has been a partner of justice in cases where specific knowledge in several areas is indispensable for the solution of a legal demand. The expression "forensic", comes from the *Latin forensis*, which means belonging to the forum, because when someone committing a crime in Ancient Rome, it would be tried and defended in front of a group of people, where the one who presented the best arguments would determine the outcome of the trial. That is, the word "forensic" brings in itself the hidden concept that a supposedly criminal act can be defended through legal proof (Góngora, 2018).

History shows that scientific knowledge for many years has been an essential element in the reconstruction of facts and the determination of criminal authorship (Bell, 2005; Crispino, 2008; Eckert, 1996). The historical records under the use of science to assist justice are mostly related to criminal investigations, which can be understood through the literature. One of the oldest records on the resolution of a forensic case using the scientific method occurred during the Chinese Quin dynasty (721-707 BC). Engraved on a bamboo board, it contained information on the solution to serious offenses through tangible evidence. There are reports that a Chinese treaty drawn up near 1204 BC, entitled *Hsi Yuan Lu*, brought instructions on *post-mortem examinations* and reference to antidotes for certain types of poisons. Also in China, in 1248, the first book was written that addresses the resolution of criminal cases using medicine and entomology during the Song dynasty, by Song Ci himself (Góngora, 2018; Hebrard & Daoust, 2013). Still in the East, there are references to Justinian as being responsible for recognizing, in the Middle Ages, doctors as special witnesses, even if the judge was not obliged to listen to them (Coêlho, 2010).

On the European continent, it is believed that from the canonical legislation of Innocent III, of 1209, the law began to regulate more specifically forensic analyses. In this case, the medico-legal analyses are highlighted, since the law referred to the injury tests to be brought to trial (França, 2016). In the mid-1500s, the practice of legal medicine was carried out in this continent. In 1575, Ambroise Paré published *Des Rapports et des Moyens d'Embaumer les Corps Morts*, which is a treatise used as a reference on the subject (Stumvoll, 2019).

It is understood that these were initiatives of great importance for the time, because before there was a solid scientific basis and laws determining the solution of the cases, the evidence was evaluated by spiritual, magical, and exoteric means, according to the society in question. These elements had a great influence in the final decision and, through some tests, it was believed that God would give signs that a suspect was innocent or guilty (such as the code of Hammurabi in Ancient Egypt). Due to the limitations of these non-scientific methods, testimonies and confessions were considered as evidence (Hebrard & Daoust, 2013).

Thus, only with the development of a more rationalist idea that scientific techniques began to be

used with greater reliability in the various areas of society, including legal demands. From the 17th century on, scientists understood the need to question the knowledge acquired through the senses, which culminated in the development of more specific methodologies. In 1637, Descartes published the treatise entitled *Discourse of the Method* (In French, *Discours de la méthode pour bien conduire sa raison, et chercher la vérité dans les sciences*). This work presented the objective of demonstrating the importance of the scientific method and tracing a path proper to science, seeking to define objects from a delimitation of what does not necessarily compose them. In other words, an object of experimentation could be reproduced universally. Descartes argued that the bases of science are the object and method. The Enlightenment movements were also responsible for the establishment of a more rationalist idea, which stimulated reflections based on the laws of reason (Bráz, 2016). It was at this moment that the main methodological bases of scientism were established, which served as a framework for the even more vertical improvement of knowledge in the following century.

In the 19th century, still in this scenario of scientific development, Augusto Comte was one of the main exponents. His main work, *Course of Positive Philosophy*, served as a driving force for positive-scientific thought (Comte, 1875). Science became the main source of answers and the construction of truth, transforming everything possible into something scientific (Beck, 2018). In line with this intellectual and philosophical movement, forensic analyses were impacted proportionally. More specifically, in Brazil, the Faculty of Medicine of Rio de Janeiro inaugurated its first practical course on legal medicine in the mid-1800s. Even at that time, the then Code of Criminal Procedure of 1832 defined *corpus delicti* exam in chapter IV "OF THE FORMATION OF GUILT". This legislation brought the figure of the criminal expert and associated the technical character with the "description of the truth".

In the 20th century, under the purview of mathematics and physics, scientific knowledge and its applications gained an even more dynamic context, based on the acceleration and the greater precision of quantification tools (Beck, 2018). In Brazil, it was possible to perceive the need for standardization of forensic procedures. An example of this is Decree No. 24.531/1934, which regulated the Legal Medical Institute and the Office of Scientific Research of the Federal District, whose activities described, among others, were "to carry out all research, analysis and physical, chemical, physicochemical and mechanical examinations of its specialty that are requested by the police authorities, judicial and administrative, civil and military", "conducting expertise and examinations" and "providing the authorities with the technical elements of elucidation that become necessary in the course of investigations".

The use of science to aid justice is not necessarily restricted to the criminal landscape. However, for this work, the approach was made in this panorama, since most historical records on the subject are in this context. More specifically, forensic evaluation can be associated with the universe of criminal sciences. Criminal sciences focus on the study of the crime itself and use a multidisciplinary evidence-based problem-solving approach. To this end, they bring together the disciplines arising from the social and natural sciences, employing diverse scientific knowledge and methods for the development of practical and ethical

ways to reduce crime and increase security (Wortley et al., 2018). A forensic investigation can be an important tool to contribute to the management of justice, based on concepts, methods, and empirical evidence from various fields and using a set of scientific disciplines applied to case resolution (Cockbain & Laycock, 2017; Eckert, 1996; Haack, 2009; Old et al., 2017). However, the perception that the use of science has a purely technical function within the process, as a simple aid to justice, may not encompass all the necessary nuances within a criminal context (Eva Bruenisholz, 2015; Morelato et al., 2013; Ribaux et al., 2003; Roux et al., 2018). The identity of forensic science must be intrinsically related to the way science is applied in the administration of justice. The concept of forensic science must be worked on because the absence of an established identity for this area of knowledge affects the formation of a coherent exercise for acting in the judicial process (Morgan, 2019; Roux et al., 2018).

Thus, the objective of this work was to perform a conceptual evaluation of forensic science, to better understand the essence of this area of knowledge. For this, the literature review was used to understand the particularities of forensic scientific evaluation and its possible use in an intelligence context. The proposal was to identify how the theme is understood in our country (Brazil) and make a parallel with the international scenario. The analysis of different realities is an excellent opportunity to align the understanding of internal problems with international definitions and indications.

2 METHODOLOGY

Initially a literature review was performed to gather information about the subject (Booth et al., 2005; Tavares De Souza et al., 2010). This type of review consists of a study tool whose objective is to investigate a specific matter, to fill gaps that hinder its understanding. Research-based on bibliographic reviews is an important scientific instrument to integrate and relate knowledge from various scientific areas (Booth et al., 2005). At first, the idea was to evaluate metrics related to publications on the subject over time. The database chosen was Google Scholar, due to its wide search reach, its democratization of access because it is a free tool, and the possibility of a greater temporal gradient of data (Barreto & Nunes, 2020).

To direct and give a more specific focus to the research, the following Portuguese language search descriptors were used: "*ciência forense*", "*ciências forenses*" and "*inteligência forenses*".³ The term "inteligência forenses" was inserted to investigate whether science has been used in information management in investigative intelligence. To understand these results in the context of a differential reality, searches were also made in the English language using the terms "forensic science", "forensic sciences" and "forensic intelligence". In both studies, data were collected regarding the last 25 years (1997 - 2021), to have a time frame on the number of publications. The focus adopted aimed to identify the development of the discussion of the theme in the literature and the quantitative number of materials already published

³ It is important to point out that the search was conducted in portuguese and, at another time for comparison purposes, in English. Therefore, it is important to leave the descriptors exactly as they were used. They can be translated into English as: forensic science, forensics sciences, forensic intelligence.

(Silva & Melo, 2018).

The inclusion criteria used were: (a) articles in Portuguese; (b) articles in English; and (c) materials published between 1997 and 2021.

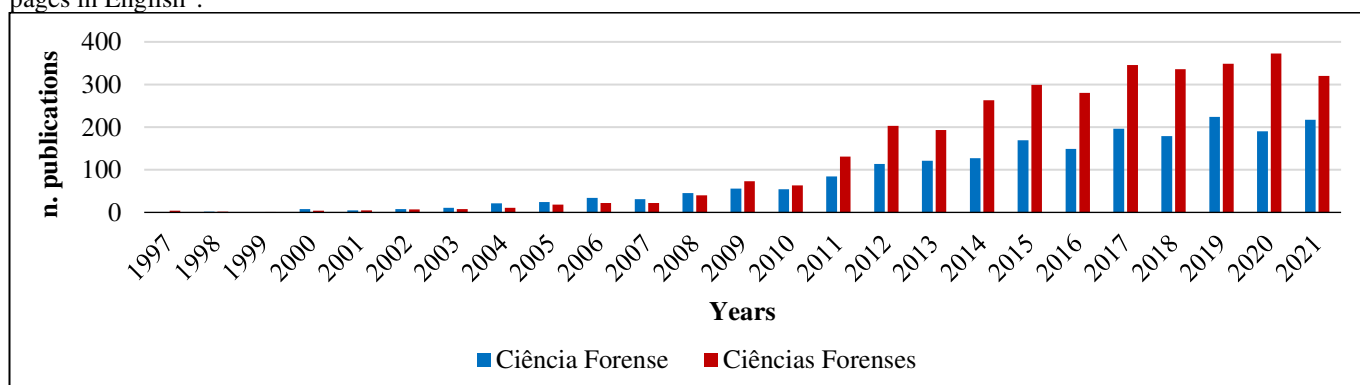
Exclusion criteria were: (a) articles that did not belong to the focus of the review; (b) articles that did not provide support for discussions; (c) articles that were specific to other areas of law that were not related to the scientific part; and (d) meetings abstracts, citations or patents.

With these well-established criteria, the papers were initially analyzed by their abstracts and keywords. Those that fit the research objectives were read in full. Thus, this research prioritized texts of scientific analyses and discussions on the subject in focus, seeking to integrate this information in the light of forensic science.

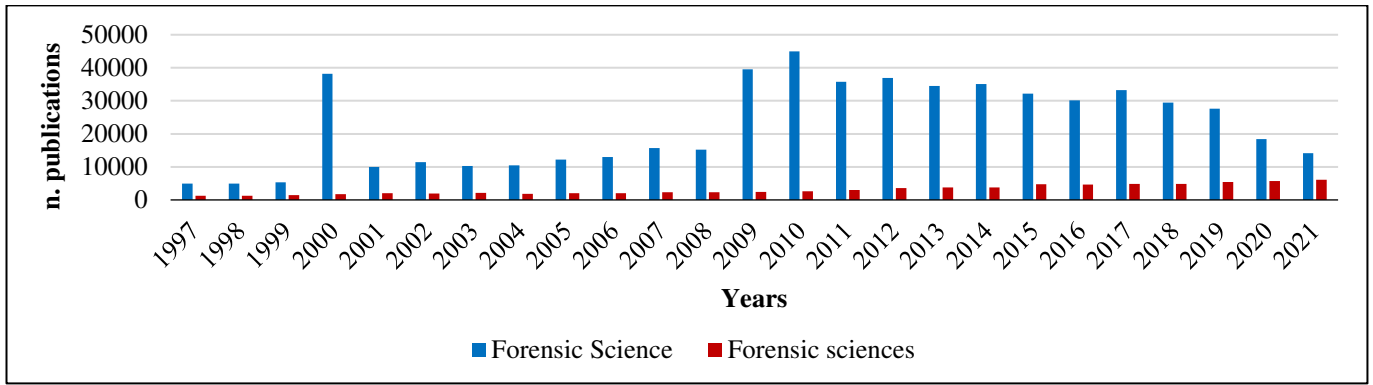
3 RESULTS

To understand how the theme of forensic scientific evaluation is addressed nationally⁴ and internationally, **Figure 1** presents the results of the bibliographic search in the Google Scholar database in the last 25 years (from 1997 to 2021). **Figure 1(a)** presents the results of the terms: "*ciência forenses*" and "*ciências forenses*". The survey was made according to the option "search pages in Portuguese" and data were collected in May 2022. **Figure 1 (b)** shows the results found for the terms: "*forensic science*" and "*forensic sciences*" using the search option "search pages in English".

Figure 1. Comparison between the terms used (a) referring to the terms "*ciência forenses*" and "*ciências forenses*" using the option "search pages in Portuguese"; (b) referring to the terms "*forensic science*" and "*forensic sciences*" using the option "search pages in English".



⁴ Brazil



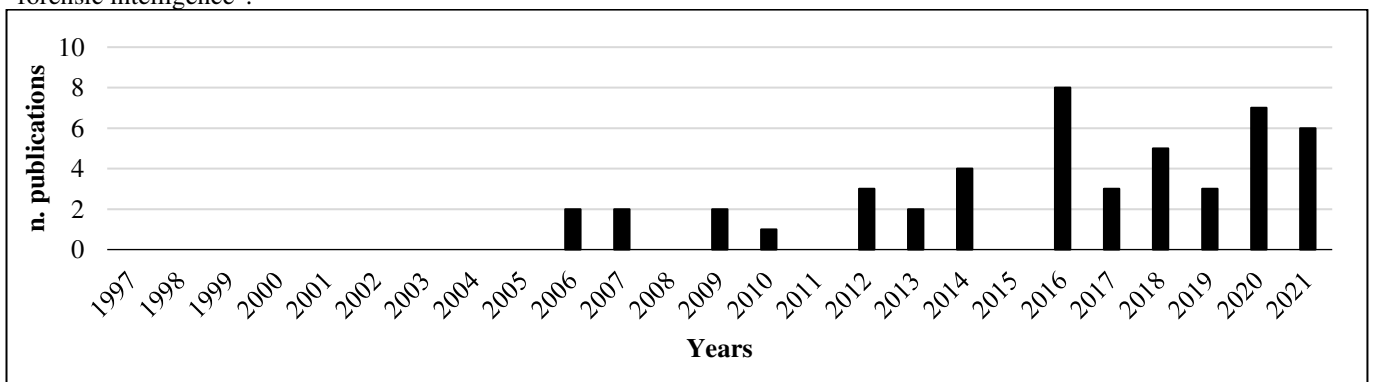
(b)

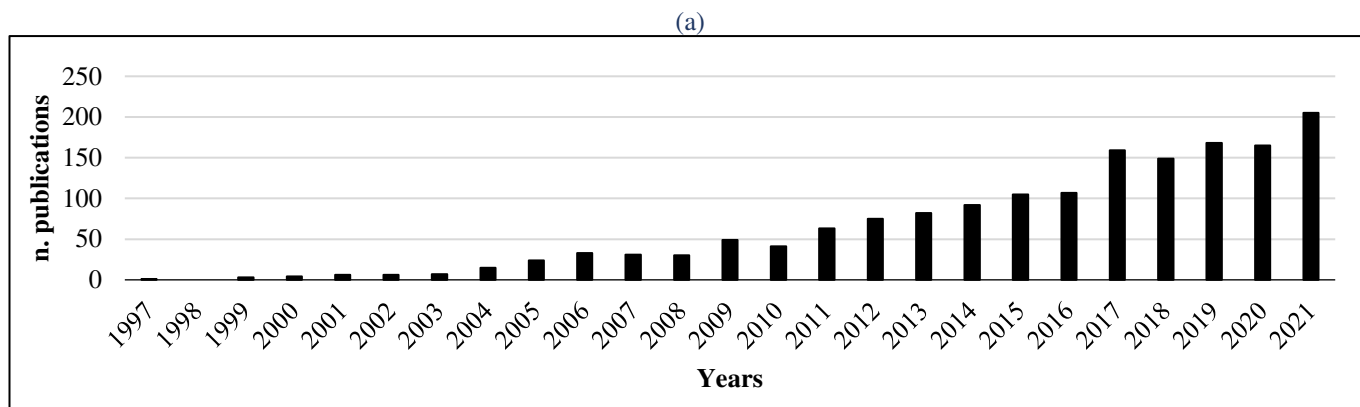
Source: Elaborated by the authors.

A significant difference is observed between these two charts. In the search Portuguese (**Figure 1(a)**), it is observed that both terms show growth in the last 25 years. In addition, it can be analyzed that the term "*ciências forenses*" has been more used than the term in the singular, having records of almost 400 citations in recent years. In the case of English descriptors, it was observed t a trend of growth in the period prior to the analyzed period. In both cases, there was an increasing rise in citations, showing that the theme has found greater interest over the years.

Regarding the data related to searches on "*inteligência forense*" and "forensic intelligence", these were grouped and presented in **Figures 2(a)** and **2(b)**, respectively. This separation of the other data was used because some descriptors returned very small values when compared to the other evaluated ones. It was understood, therefore, the need to expose the datas alone.

Figure 2. Comparison between the terms used being (a) referring to the term "*inteligência forense*" and (b) referring to the term "forensic intelligence".

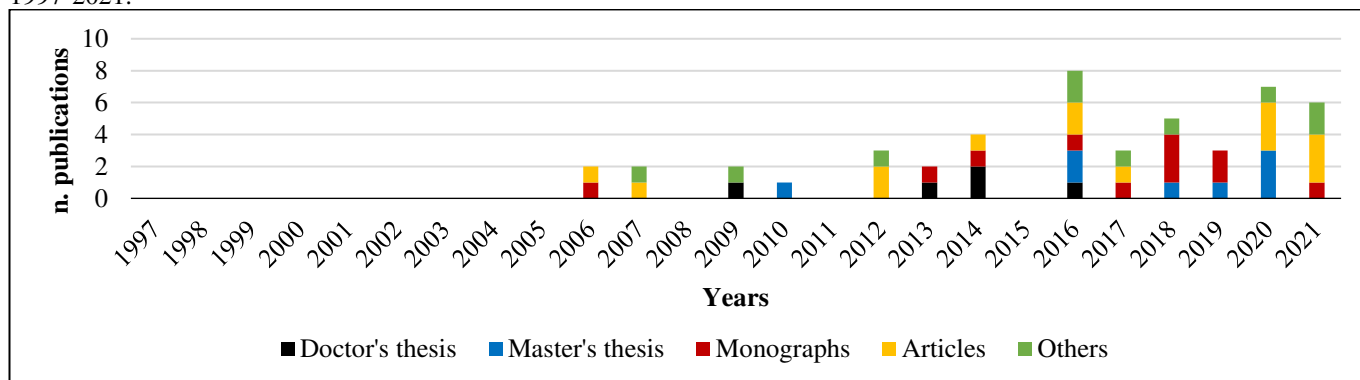




(b)
Source: Elaborated by the authors.

Based on Figure 2, it is observed that in both descriptors there is a trend of increase in the number of indexed studies in the last 25 years. However, the volume of studies that used this descriptor was still small, so we chose to categorize them. Thus, Figure 3 groups the different types of works that used the term "*inteligência forense*". This assessment becomes important since forensic intelligence understands the use of forensic science for decision-making.

Figure 3. Different formats of works involving the theme of "*inteligência forense*" are available in Google Scholar between 1997-2021.



Source: Elaborated by the authors.

Of all the papers published in the period and shown in Figure 3, 10.4% (5 out of 48) came from doctoral theses, 16.7% (8 of 48) from master's dissertations, 22.9% (11 of 48) from monographs (final paper), 29.2% (14 of 48) from scientific articles and 20.8% (10 out of 48) from other media, such as books, book chapters, opinion articles, among others.

4 DISCUSSION

Based on the results obtained, some observations can be made. About Figure 1(a) it is possible to note that the publications that presented the descriptors "*ciências forenses*" and "*ciência forense*" only reached their first hundred indexed materials in 2011 and 2012, respectively. For Figure 1(b), which presents the results for the source made in English pages, these values already exceeded the thousands in the same period. When comparing Figures 1(a) and 1(b), an opposite trend is observed between the terms

in the singular and plural. In the case of **Figure 1(a)**, there is a higher incidence of the term in the plural. In **Figure 1(b)**, the term "*forensic science*", in the singular, is more used in the literature available in English language than the term in the plural, reaching peaks of around 40,000 citations in a year. The research on "forensic intelligence" (**Figure 2(b)**) shows timid results, but there is a constant increase.

Moreover, when analyzing the *descriptor* "forensic intelligence", it is perceived that the first hundred publications were surpassed in 2015, while the same term in Portuguese has not yet reached the tens. There is almost no mention of the term "*inteligência forense*" when compared to the other terms, showing that in the pages in Portuguese this theme has not yet flourished for research.

Considering the results presented, it is understood that the studies on the subject are still really incipient in Brazil, being more in charge of review papers and monographs, as shown in **Figure 3**. To deepen this discussion, we sought to find a majority conceptualization for the theme, to make an alignment of the national approach with international understanding.

In an international context, a group of scientists from several countries came together to write a document entitled "Sydney Declaration" (Roux et al., 2022). This statement emphasizes the absence of a unified understanding of the essence, purposes, and principles of forensic science. It also provides a need for reflection on its impact, revisiting its definition and establishing seven fundamental principles that support the practice of forensic science, indicating guidelines for teaching and research.

According to the Sydney Declaration, the following definition is set (Roux et al., 2022):

Forensic science is a case-based (or multi-case-based) research-oriented endeavor using the principles of science to study and understand – the remnants of past activities (such as an individual's presence and actions) – through their detection, recognition, and examination to understand anomalous events of public interest (e.g., crimes, litigations, security incidents).

According to the Sydney Declaration, forensic science encompasses any kind of anomalous event in the public interest and is therefore not limited to the universe of criminal law. In Principle 1 of the Sydney Declaration, it is established that, inevitably, every action leaves traces, according to the Locard Exchange Principle (Maia, 2012; Mistek et al., 2019).

Principle 1: Activity and presence produce traces that are fundamental vectors of information. A precondition for a forensic science investigation is that activities cannot occur without leaving traces. Sometimes they are left at the scene; sometimes they are taken away (Locard's exchange maxim). The nature of the activity influences the types of items that are exchanged, and how and where they are dispersed in the environment. This item(s), a remnant of the investigated activity, is the trace. The trace is a vector of information that is capable of being detected, examined and interpreted. The traceability of human activities is rapidly changing in our digitalised (i.e., combined physical and digital) environment. The place of forensic science is therefore increasingly central to studying events of public interest, which are themselves in transformation.

As provided for in Principle 1, it is important to make it clear that Forensic Science is not limited to Criminal Law. However, as already mentioned in the introduction, it is intended to evaluate the theme within the criminal aspect. In this context, in Brazil, the article 158 of the Code of Criminal Procedure

declares the mandatory *corpus delicti* exam when an offense leaves traces, the wording of which says that "when the offense leaves traces, it will be indispensable the examination of the body of the crime, direct or indirect, and cannot supply it by the confession of the accused". In addition, in line with the Sydney Declaration, Law No. 13.694/2019, also known as the "Anti-Crime Package", changed the Brazilian Code of Criminal Procedure and brought indications about the trace and control of traces, which are inserted in the articles referring to the Chain of Custody (articles from 158-A to 158-F).

Thus, the *corpus delicti* is composed of traces that, after analysis, can be used in the reconstruction of the phatic dynamics. The *corpus delicti* exam direct consists of the technical-scientific analysis of the traces, while indirect corresponds to the analysis of the secondary elements that can help in the interpretation of the facts (Bruni, 2020; Cunha & Pinto, 2021). Thus, for the traces to be analyzed, there is no need to dispense with science. This is under Principle 2 of the Sydney Declaration, which states that the investigation of a crime scene consists of a scientific effort to reconstruct an event from the study of the remaining traces. This action undeniably requires an expert analysis.

Principle 2: Scene investigation is a scientific and diagnostic endeavour requiring scientific expertise. The goal of the scientific investigation at the scene is to infer (i.e., reasoning under uncertainty) the reconstruction of an event through the study of the surviving traces. The site of an event is where relevant traces can be recognised and characterised with respect to their relative position that may be indicative of sequence, orientation and interaction. This information combines to help understand a limited number of potential explanations relative to the traces that need further examination and interpretation in the reconstruction and identification processes. This complexity requires a trained mind with broad science knowledge and with powerful and proficient observation and detection skills that may be extended by various scientific tools.

Principle 3 reinforces the need for research to take place through scientific knowledge, investigative methodology, and logical reasoning.

Principle 3. Forensic science is case-based and reliant on scientific knowledge, investigative methodology and logical reasoning. Traces constitute signs and forensic science engages a scientific process to investigate and understand the meaning of these signs with their ambiguities, misperceptions and strengths. This engagement involves asking relevant questions (mostly context dependent), making observations, forming propositions and testing that propositions. This testing may include measurements facilitated by technology, but such tests are only an extension of the scientific process. The process is characterized by critical thinking, logical reasoning (deductive, inductive, abductive and analogical), problem-solving and informed judgment. This approach is rendered ineffective – and perhaps even counterproductive – if it is not applied within a logical framework using a well-understood investigative methodology.

This principle, therefore, emphasizes the importance of applying reliable analysis that can be obtained through the technology development. The idea is that legal decision-making can be based on the credibility of scientific findings.

Principle 4, in turn, deals with the importance of forensic science to reconstruct the truth from past events, taking into account the difficulties of the passage of time in the interpretation of traces.

Principle 4. Forensic science is an assessment of findings in context due to time asymmetry. In many instances, the quality of the trace resulting from an activity is such that it is incomplete, imperfect, and/or degraded by the passing of time, with such losses increasing uncertainty and often supporting only approximations concerning the past event under investigation. The ground truth remains in the past and is largely inaccessible. Forensic science can only be used to construct a model that is descriptive of a given scenario, explained by what is observed. The context is therefore essential. This is not a general model, but a specific retrodictive model that can only be inferential. Forensic scientists cannot determine with certainty the definitive circumstances surrounding a trace, but only assess the relative value of associated findings under different plausible causes or scenarios. Such assessments should be unbiased and founded on scientific rigor and transparency.

Concerning the idea of truth, it is interesting to note that the Sydney Declaration itself brings a concept that is historically debated in the context of criminal proceedings, namely that of the "real truth". The controversy arises from the question of whether or not it is possible to achieve an absolute (or real) truth. Despite adopting different theories about truth, researchers (Beltrán, 2017; Lopes Jr, 2020; Tavares & Casara, 2020) claim that it is not possible to achieve the "absolute" truth, that is, to see the fact is relative "in the sense that it is impossible to achieve a knowledge that corresponds reality of past events" (Badaró, 2019). The idea, therefore, is that the exercise of reconstruction of the facts performed within the criminal procedure, from the analysis of the evidence, can demonstrate in the most reliable way possible what occurred in the specific case. This concept aims to achieve a level of knowledge about the fact (the truth), but knowing that it will never reach the absolute truth itself.

This idea is exposed by the Sydney Declaration when Principle 4 clearly states that "real truth remains in the past and is largely inaccessible." What is observed is that even in the area of forensic science it is recognized that it is not possible to achieve an absolute truth. This is exactly in line with the idea previously presented, in that it recognizes that there are technical and methodological limitations that make absolute knowledge about something impossible. Principle 4 is a turning point in the forensic area, as it assumes that the application of science alone is not something strictly assertive and unquestionable. It admits that there are limits that must be recognized that there are errors that can occur and, mainly, that the study and understanding of these technical phenomena are of utmost importance for offering a quality expert evidence and the enforcement guarantees and fundamental rights of criminal proceedings.

Principle 5, in turn, establishes the need to understand the doubts inherent to the exercise of forensic science, as well as the importance for these uncertainties to be adequately identified and quantified.

Principle 5. Forensic science deals with a continuum of uncertainties. Forensic science deals with a continuum of uncertainties that are present at every step of the process that starts with the generation of traces and moves through all the steps up to the communication of the findings and value to the intended recipient (whether reported in written documents or in oral form such as their presentation in Court). Research is needed to identify and quantify these uncertainties with the knowledge that uncertainty will never be eliminated.

Principle 6 indicates that the purposes and contributions of forensic science are multidimensional and that the systematic study of traces can aid knowledge about crimes and damage to society, besides being indispensable for decision-making in judicial proceedings.

Principle 6. Forensic science has multi-dimensional purposes and contributions. The purposes and contributions of forensic science are multi-dimensional. Through the systematic study of traces, forensic science (1) brings knowledge on crime, illicit markets and various mechanisms that cause harm or are of concern to society, (2) contributes to incident investigations, and (3) supports decision-making in legal proceedings. Forensic science provides the scientific basis for the practice of a variety of functions and professions related to crime, deviance and social response.

In Principle 6, the importance of trace analysis to feed intelligence procedures is emphasized, and may play a fundamental role in the broader structure of the criminal justice system. Thus, confirming what has already been said, forensic science is not only reactive and oriented to the mere isolated resolution of a case. Its mechanisms can and should be used to contribute to broader issues within the justice system. These integrated mechanisms can help to prevent crime, as well as harm reduction. This is in line with the already discussed focuses of the criminal sciences.

Finally, Principle 7 establishes the need for impartiality of professionals involved in forensic science, reinforcing that they must be faithful to science to ensure the ethics and independence of their findings.

Principle 7. Forensic Science findings acquire meaning in context. Forensic scientists need to act ethically and with impartiality, transparency and independence to ensure they remain true to science so that the information they provide for the potential resolution of the activity under investigation is useful and reliable regardless of who benefits from the information. Forensic scientists must defend their results and opinions as appropriate while acknowledging any plausible alternatives. When evaluating findings, at least two alternative propositions should be considered.

Thus, under the principles set out in the Sydney Declaration, it is understood that forensic science should be conducted in an integrated manner. The expansion of knowledge requires cohesion between different disciplines, as problems become more complex and require more comprehensive ways to solve these issues. Thus, an approach with combinations of the natural, social sciences and humanities can offer many benefits (Choi & Pak, 2007; Mokiý, 2019; Payne, 2015). Efforts in multi, inter, and transdisciplinary exercises can be helpful in enriching discussions in various areas of knowledge (Choi & Pak, 2006). These terms are often used as equivalents (Merriam-Webster, 2022) but actually present distinctions and similarities that must be highlighted. The clearest similarity is that more than one discipline is involved in each type of effort (Payne, 2015). The distinctions are important so that each of these concepts can be applied appropriately to the situation of interest.

In general, multidisciplinary has an additive characteristic because it uses the knowledge of different disciplines, without the concern of integrating them, that is, maintaining its limits. Interdisciplinarity, in turn, corresponds to the integration of disciplinary perspectives to analyze, synthesize and harmonize different knowledge in a coordinated and coherent way. Finally, transdisciplinary integrates disciplines, allowing them to cross their borders to create new knowledge (Choi & Pak, 2006; Payne, 2015).

Considering these differences, it is observed that most bibliography in Portuguese use the term in the plural, that is, “*ciências forenses*”, and associate the definition of this area of knowledge with the

multidisciplinary context (Eckert, 1996; Old et al., 2017). By treating forensic science in a compartmentalized way, it is a set of non-integrated or multidisciplinary sciences, and the importance of its contribution to the justice system is narrowed. This makes it impossible to comprehensively understand forensic science, preventing it from being considered an autonomous science. Thus, it is understood that the interdisciplinary approach can provide a relationship between several perspectives to analyze, synthesize and harmonize this different knowledge, being a means to study subjects that cannot be approached satisfactorily by a single discipline (Choi & Pak, 2006; Payne, 2015). Considering forensic science in an integrated manner assists in collecting data that can be used efficiently in forensic intelligence mechanisms. Information from forensic cases can be used for criminal monitoring and investigations, expanding the scope of forensic science and allowing its findings not to be restricted to the laboratory (Ribaux & Talbot Wright, 2014). In this case it is possible to identify trends in the detection and investigation of crimes, and may even assist in prevention mechanisms. It should therefore be understood that forensic science consists of an interdisciplinary effort to promote strategic thinking from the application of scientific knowledge to understand an event of public interest.

The transformation of trace analyses into useful evidence to explain a criminal hypothesis can increase the efficiency of mechanisms in public safety (Clarke, 2004; Cockbain & Laycock, 2017; Laycock, 2005; Lopez et al., 2020). The collected data can be used to formulate hypotheses that are tested to explain observed findings (Clarke, 2004; Cockbain & Laycock, 2017; Laycock, 2005). In addition, it is important to take into account all the uncertainties involved. Scientific mechanisms should be used to improve the justice system, properly connecting evidence to the fact (Esseiva et al., 2007; Junker, 2017; O'Brien et al., 2015; Ribaux et al., 2006; Roberts, 2015). Thus, it is expected that legal issues and criminal investigations will be conducted in an impartial, ethical and transparent manner, so that scientific evidence is properly used within the criminal justice system (Morgan, 2018; Payne, 2015; Roux et al., 2022). Doubts about the effectiveness of forensic assessment should be avoided as much as possible (Ribaux et al., 2014). The compilation and interpretation of scientific data within the legal universe are essential to reduce the risk of misinterpretations and to promote greater certainty in decisions (Morelato et al., 2013, 2014).

Finally, the classical definition of forensic science as the mere scientific technical evaluation of traces to aid law enforcement should be expanded. An understanding not only of the concept of forensic science, but also of its scope, principles and foundations is essential for the data generated to be employed within an information and intelligence process in a scenario of investigative coherence (Morelato et al., 2013; Ribaux et al., 2003, 2006, 2010). The absence of an identity that demonstrates what forensic science really means and what its purpose can affect its consistency and acceptance in the justice system and by the operators of law (Morgan, 2019). The procedures in forensic science go far beyond that only to use in an additive way the different disciplines for the analysis and interpretation of traces. The degree in which forensic science is considered a coherent, interdisciplinary and unified discipline helps in its development, in determining the challenges it can face and in how successful it will be for resolving judicial conflicts

(Morgan, 2019).

5 CONCLUSION

Conceptual studies on forensic science are practically nonexistent in the Brazilian literature. This research aimed to develop a conceptual approach to the idea that permeates forensic science. For this, it is understood that the use of the term in the plural, that is, forensic sciences, refers to a multidisciplinary and, therefore, additive character. This means that this concept is linked to the simple use of different techniques for the mere analysis of traces. But forensic science is much more than that.

In Brazil, the bibliographic search showed that most references use the term in the plural. This finding illustrates the dissonance concerning international studies, whose most abundant term was found in the singular. The term in the singular refers to a conceptualization of forensic science as an autonomous science. A historical approach to the use of science to assist in the resolution of cases of legal interest shows that the importance of the theme increases over time. However, forensic practices should not be used for mere scientific analysis of traces. Interdisciplinarity must connect both technical and legal knowledge in a decision-making context, seeking to feed intelligence mechanisms.

The Sydney Declaration is the latest document that emphasizes these understandings. In this text, the authors revisited the conceptualization of forensic science and establish seven fundamental principles for conducting forensic evaluation. These principles cover a series of themes related to forensic science and emphasize trace analysis as an indispensable mechanism in the investigation of legal events. The document reinforces the importance of using the scientific knowledge and logical reasoning for the study of traces. Furthermore, the text draws attention to the fragility of forensic evaluation not being over considered, in addition to the importance of ethics and critical thinking on the part of forensic scientists. This statement is intended to guide the practice of forensic science, treating it as an investigative, teaching and research tool, in a clear driving motion to make these procedures more effective and reliable.

Finally, it is concluded that the discussion is broad and goes beyond the points addressed in this paper. It is expected that this is initial research to (re)think about the theme and provide a reflection for the subject, especially about a necessary alignment with international references. It is intended that the results and discussions presented inspire other researchers to reflect on the subject, because there is a fertile field for research related to forensic science. This perspective favors the solidarity of the area as an autonomous and interdisciplinary science, providing a greater understanding of its objectives and its importance for the administration of justice.

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