Forensic Science International: Synergy 6 (2023) 100312

Contents lists available at ScienceDirect

Forensic Science International: Synergy

journal homepage: www.sciencedirect.com/journal/forensic-science-international-synergy

Why admitted cases of AHT make a low quality reference standard: A survey of people accused of AHT in France

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A B S T R A C T

Several influential articles that attempt to establish diagnostic methods for Abusive Head Trauma (AHT) use admitted cases as a reference standard. This study analyses a survey of people accused of AHT in France, to understand the environment and situations in which such admissions are made. Multiple reasons to question the reliability of admissions to AHT are demonstrated in the responses, including reduced sentences, the return of children to the family home, a desire to stop accusations being leveled at a partner and for legal proceedings to end. These factors must be considered in the context of proceedings that are long, expensive and stressful, leading to depression and financial hardship, and that seem to be inevitably heading towards conviction. The ineluctable conclusion is that admitted cases do not make a suitably reliable reference standard for undertaking scientific investigation, or for validating the diagnostic methods used for AHT.

1. Introduction

Diagnosis of Abusive head trauma (AHT) is a controversial area of medicine, particularly the subset of AHT that has been attributed to acceleration and deceleration forces that result from shaking [1], which has traditionally been known as Shaken Baby Syndrome (SBS).

Evidence purported to justify the diagnoses of AHT has long been criticized for relying on circular reasoning [2–6]. Cases diagnosed as AHT [7] are used as a reference standard in studies that attempt to determine which findings should be used to diagnose AHT. The reference and diagnostic tests are the same. That is, researchers use as a reference standard those cases previously diagnosed as AHT by physicians or multidisciplinary teams. So the reference test is based on the set of findings that are *assumed* to be associated with AHT. Once these cases are identified as being "true positive" AHT cases, then researchers look at the findings in these cases to determine the diagnostic test. But these findings are simply those that were already *assumed* to be associated with AHT, those adopted in the reference test. Such circular reasoning fails to provide scientific validation for the assumed diagnostic methods used by physicians and/or multidisciplinary teams.

Attempts to circumvent this methodological flaw have generally taken one of two routes: 1. excluding target findings from the criteria used for the reference test, and 2. using cases where admissions of abuse were made.

Whilst on the face of it, route 1 avoids circular reasoning, it does not solve the problem of having an unreliable, inadequate reference standard. One such study [8], for example, aimed to study the types of Retinal Haemorrhage (RH) that occur in AHT. To classify cases as AHT, the study used predetermined criteria that are independent of ophthalmic findings: the reference standard excluded information on retinal hemorrhages. These predetermined criteria include "Multiple injuries incompatible with accidental childhood injury" as being "definite abuse". So the physicians making the diagnosis *must already believe* that these types of injuries are strongly indicative of AHT, and that the diagnosis can be reliably made without reference to retinal haemorrhages at all. The criteria did not provide a robust reference standard, from which one can have confidence that the cases classified as AHT were categorized correctly. By making the classification of AHT without reference to RHs, the study implicitly assumed that AHT can be accurately diagnosed without reference to RHs, even though they conclude that RHs are an important finding in the diagnosis of AHT.

Route 2 aims to solve the problem of circular reasoning by using admitted cases as the reference standard [9]. If admitted cases are assumed to be true AHT, the findings in such cases can be compared with

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https://doi.org/10.1016/j.fsisyn.2022.100312
Received 25 October 2022; Accepted 19 December 2022
Available online 29 December 2022

the findings in cases that have been diagnosed as AHT by physicians and/or multi-disciplinary teams. Studies have consistently shown that the findings in these two sets of cases, admitted and diagnosed, are statistically similar [10–14]. This is presented as evidence for the accuracy of the diagnoses in the diagnosed AHT case. Indeed, these "confession based studies" are often cited as providing the central evidence base for the SBS hypothesis [15,16].

However, there has been considerable criticism [17–19] of using admitted or confessed cases as a reference standard, in particular when the details and circumstances of the admissions are not provided. One aspect of this is plea bargains, which are common in many jurisdictions. It is widely acknowledged that innocent people regularly plead guilty to all types of crimes [20–22]. For cases of AHT, the prosecutor has a significant amount of bargaining power, because charges can range from murder, carrying life sentences or even the death penalty, to lesser charges such as manslaughter that can result in sentences of a few years. The benefit to the accused of taking a plea to a lesser charge, rather than risking decades in prison or even death, are clear.

Countering the problem of plea bargains, several influential confession based AHT studies [23–25] have been done in France, where it is claimed that plea bargains do not occur. This is presented as a strength of French confession based studies. However, there are other reasons to question the reliability of admissions to AHT, and their use as a reference standard, as this paper will demonstrate.

In this study we present the results of an anonymized survey of people who have been accused of committing AHT in France, and who maintain their innocence. We draw on research literature on admissions, confessions, and guilty pleas to interpret the survey results, and the context and circumstances in which admissions are made in AHT cases.

2. Materials and methods

2.1. The Adikia survey

The anonymous survey was conducted between December 2020 and July 2021 with families who had been in contact with a French nonprofit association, Adikia [26], which provides support groups to families disputing medical diagnoses of child abuse. The subjects were reached via a mailing list and social media handled by the association. The survey received answers from 150 people who have been suspected or accused of inflicting AHT in France between the years 2004 and 2021. The cases are weighted to more recent years; at least in part, this is probably because more recent cases were more likely to respond. The survey was conducted with the Google Forms online service. There were 112 questions covering demographical, medical, and legal information. Most questions were single or multiple choice questions. Many questions were optional. Responses were anonymized: no email address, name, or IP address was recorded. The data attached to this article does not contain any information allowing for identification or recognition of individual cases.

When answering the form, participants agreed to let researchers analyze the data and publish statistical aggregates for scientific purposes. They were instructed to fill one form only per case (e.g. when both the mother and father were accused, only one of them should have filled the form).

Among the 150 responses, we first identified duplicates (e.g. when several persons concerned by the same case filled a form, despite the instructions) by matching years, months, regions, age and sex of the child. We also only kept SBS/AHT cases, since a few respondents were concerned with cases of bruises or fractures with no intracranial injury (battered child syndrome instead of SBS/AHT). Finally, we only kept respondents who answered "no" to the question: "Do you think the child's medical findings have been caused by violent gestures?" Three respondents had answered "yes" to this question (a childminder and two mothers who believe that other persons inflicted the AHT) and were excluded from the analysis.

We were left with 118 unique SBS/AHT cases. All respondents deny inflicting AHT and believe that no AHT occurred. Among this group, there were 97 cases involving police interrogation.

Questions and answers relevant to this article are shown in Figs. 1–5, with a link to the data release of the survey provided as an appendix. An extended interview was made (prior to the survey) with one of the survey participants who claims to have falsely confessed. This interview (with a few retractions to hide the identity) is included in the Appendix.

3. Results

Fig. 1 shows responses to yes/no questions. Out of 97 respondents who underwent police interrogation, 77 (79.4%) said that police presented the diagnosis of child abuse as absolutely certain and irrefutable, and 45 (46.4%) said that they had been told that confessing to abuse would let the justice be more lenient. Twenty-four (24.7%) respondents said that they had been told that confessing to abuse would allow the doctors to better treat the child. Forty-four (45.4%) said that they were told that a harmless gesture they may have done to the child may have caused the symptoms. Fourty-two (43.3%) respondents were told that confessing to abuse would allow the other parent to get the child back. Fourty-two (43.3%) came to believe, during or after the interrogations, that mild and relatively innocuous gestures could have unintentionally caused the child's symptoms. Eleven (11.3%) stated that they tried to shake the child slightly after he was unwell, in a revival attempt.

Eleven respondents (11.3%) stated that they had made voluntary false confessions in the hope of saving their spouse, or to let the child go back to the other parent. In 13 cases (13.4%), the police and justice considered that the respondent had confessed to the alleged acts (even though all these respondents deny abuse).

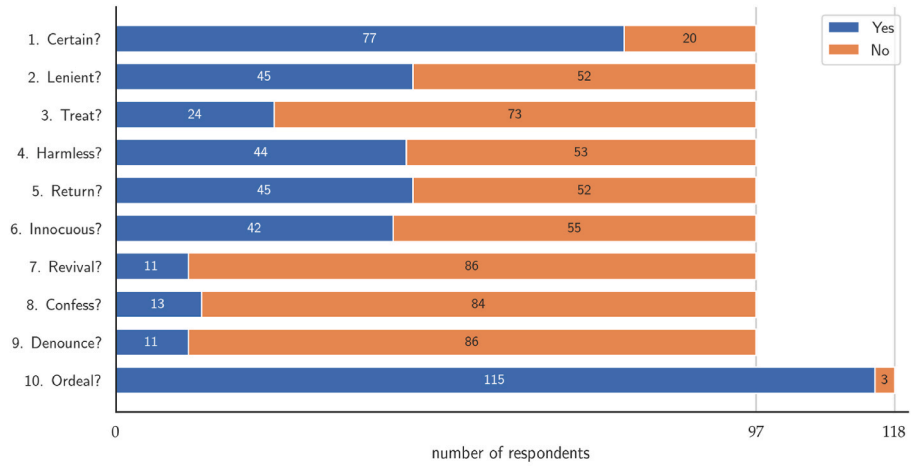
All respondents but three (115 out of 118, 97.5%) stated that this was the hardest ordeal of their lives.

Fig. 2 shows the most common responses to the question "What has been the psychological and/or medical impact [of these accusations] on you?". Some respondents gave multiple responses. Depression was the most common, along with dark thoughts and weight gain/loss. Seven respondents attempted suicide and five were admitted to psychiatric wards. Other negative impacts include panic attacks, insomnia, loss of confidence, anxiety, hair loss, post traumatic stress, pain, nervousness, and taking antidepressants.

Fig. 3 shows the box plot of the number of months children had been placed outside the family for the cases where the removal is over. The 34 cases where removal had ended had a median removal time of 7.5 months, with first quartile of 4.5 months and third quartile of 13.5 months. In twelve cases, the removal lasted more than a year, and more than two years in six cases. In one case, the child was removed for four years.

Fig. 4 shows the box plot of the length of time that judicial proceedings lasted, for the 22 cases that are over. The median time was four years, with the first quartile at two years and the third quartile at six and a half years. Some cases dragged on for more than 8 years.

Fig. 5 shows the cost of judicial proceedings for the 94 respondents who answered that question, with a median of 7500€, a first quartile of 3500€, a third quartile of 18,750€ and a maximum of 250,000€.



1. Certain? Has the police presented the diagnosis of child abuse as absolutely certain and irrefutable?
2. Lenient? Have you been told that confessing to abuse would let the justice be more lenient with you?
3. Treat? Have you been told that confessing to abuse would allow the doctors to better treat the child?
4. Harmless? Have you been told that a harmless gesture you may done to the child may have caused the symptoms?
5. Return? Have you been told that confessing to abuse would allow the other parent to get the child back?
6. Innocuous? Did you come to believe, during or after the interrogations, that mild and relatively innocuous gestures could have unintentionally caused the child's symptoms?
7. Revival? Did you state that you tried to shake the child slightly after he was unwell, in a revival attempt?
8. Confess? Did the police and justice consider that you had confessed the alleged acts?
9. Denounce? Did you make voluntary false confessions in the hope of saving your spouse, or to let the child go back to the other parent?
10. Ordeal? Is this the hardest ordeal of your life? (all 118 respondents answered that question)

Fig. 1. Responses to interview questions.

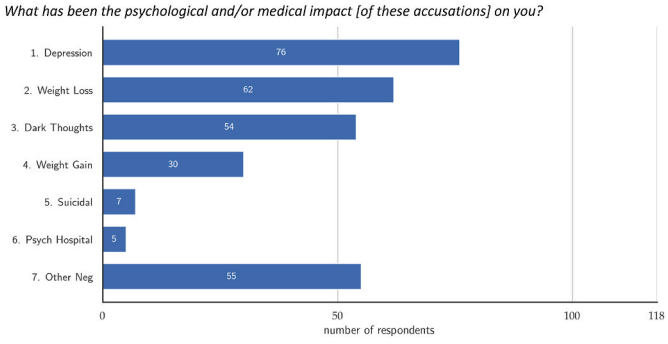


Fig. 2. What has been the psychological and/or medical impact [of these accusations] on you?
Notes:
5. Suicidal: all 7 cases include suicide attempt
6. Psych Hospital: Was admitted to a psychiatric hospital
7. Other Neg: Other negative impacts include loss of work, sickness, panic attacks, insomnia, loss of confidence, anxiety, hair loss, post traumatic stress, pain, nervousness, and taking antidepressants.

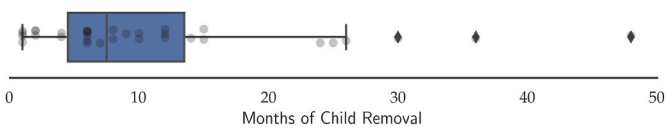


Fig. 3. How many months did the placement last, if applicable?.

Fig. 4. If all legal proceedings are over, how many years did they last in total?.

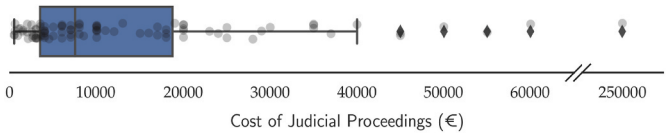


Fig. 5. What is the approximate total amount, in euros, of your expenses in lawyers' fees since the start of the proceedings?.

4. Discussion

4.1. Pragmatic and incentivized admissions

The existence of plea bargains clearly weaken the reliability of admissions as a reference standard. Yet, even in jurisdictions where one cannot negotiate which charge will be filed or amended, pleading guilty to a given charge often results in a significant reduction in prison sentences. Of those being accused of AHT in France who were interviewed by police, 45 of 97 respondents (46.4%), said that investigators had told them that confessing would lead to a more lenient sentence.

In addition, children are often removed from the family home once accusations of AHT have been made. Of the 95 cases where the infant survived, 77 (81%) involved child removal, with a median time of removal of 7.5 months for the 34 cases where the child removal was over (see Fig. 3). This removal is highly traumatic for the children and parents [27]. In a study of twelve Swedish parents who had been accused of AHT/SBS, the removal of the child was described as evoking emotions of "extreme longing, fear, desperation and hopelessness." [28].

"Assuming responsibility", or "providing an explanation" that satisfies the accusing doctors is often a condition made for the return of infants. In the survey, 42 of the 97 respondents who were accused of AHT in France and were interrogated by the police (43.3%) said that they were told that confessing would help them get their children back. Justice Madeleine Sanchez, Judge of child cases at Châteauroux High Court, has written that she does not hesitate to remove children from those who allegedly abused them, or did not sufficiently protect them, and that, "If they remain in denial, trivialize the suffering of their child, the initial terms of placement are unlikely to evolve. On the other hand, when the parent(s) advances in their awareness, the gradual resumption or intensification of links is implemented even before the end of the placement." [29].

In these circumstances, even innocent parents may decide that it is in the best interests of the children for one parent to make admissions, allowing the children to return to the care of the other parent.

Further, 76 of 118 respondents (64.4%) said they had become depressed as a result of the accusations and proceedings, with 7 having attempted suicide and 5 being admitted to psychiatric wards. Other negative impacts listed by the respondents include loss of work, sickness, panic attacks, insomnia, loss of confidence, anxiety, hair loss, post traumatic stress, pain, nervousness, and taking antidepressants. The earlier study of twelve accused Swedish families also reported depression, panic attacks, and post traumatic stress symptoms such as flashbacks, panic and anxiety.

Seeing a depressed partner, whom you believe to be innocent but is at risk of being sent to prison, combined with a chance to return the children to the care of your partner (usually the mother), provides another rational reason for innocent people to make admissions. If one makes admissions to inflicting abuse, the other partner can then be freed from the criminal process, and also have the children returned.

Considering these factors, it is perhaps not surprising that 11 out of 97 respondents (11.3%) said that they had falsely incriminated themselves, i.e., made false admissions, either in the hope of saving their spouse, or allowing the child to return to their spouse.

In the case for which a detailed interview was made with the accused father, both parents had been suspected of abuse and were being interrogated. According to the father "At about 2–2.30 p.m., they came for me and, when I left my cell, I saw the boots of my partner in front of the cell next door. This is when I broke down, I imagined my partner in jail, with everything we can imagine. It broke my heart. So I decided to "confess" something I didn't do to protect her because, to me, it's the man who needs to protect his wife and child, no matter what, no matter the price. So I asked to be heard again, to explain what I did. I said I shook my daughter." He goes on to explain that "My partner is the love of my life. If I need to spend 20 years in prison to help her get our daughter back and have a quiet life, then I'll never regret it."

Additionally, legal proceedings can last years and can be highly distressing and disruptive. For completed cases from the survey, the median time of proceedings was 4 years, with the longest time 8.5 years (see Fig. 4). All but three of the 118 respondents (97.5%) said that this was the most difficult thing they had experienced in their lives (Fig. 1). These are drawn out, stressful times for accused families, who want finality to allow them to return to some sort of normality and to plan for the future.

There are also significant costs involved in defending these accusations. The survey shows that the median cost of defending these cases is 7500€, with 25% of cases costing 18,750€, or more (see Fig. 5). Many of these cases are ongoing, meaning these are under-estimates of the typical total costs of these proceedings. This puts great financial strain on many of the accused and their families. Legal fees in France are relatively modest; running such cases can be far more costly in other countries. When combined with loss of income when one partner spends time incarcerated, these expenses can put enormous strain on families. By contrast, the state has enormous resources to fund the prosecution of these cases.

Further, there is often an inevitability about the conviction. The state can call on multiple highly credentialed medical experts, whose opinions carry great weight in judicial proceedings. In France, this is boosted by the existence of a set of protocols for the diagnosis of AHT. Such protocols were codified in 2011. The protocols include neuro-imaging, fundoscopy and coagulation and assay factor tests, before a joint declaration by the medical team, the psychologist and social workers is made to the justice attorney. The protocols specify that when particular findings that are associated with AHT are present, and differential diagnoses are eliminated, the diagnosis of abuse is "certain" [30].

Whilst these protocols remain controversial and the subject of ongoing research, they were validated in 2017 by the French *haute autorité de santé*, an independent national quality control institution. The protocols also form the basis of police policy [31], and inform the courts [32]. This has made it increasingly difficult to fight these charges, once the findings set out in the protocols are present.

The factors analysed above do not occur in isolation. Many cases involve a mix of child removal, financial burden, temporary living arrangements, uncertain future, depression and frustration, and a drawn out legal process that is heading for a conviction. Admissions (even if false) may be a *rational decision* in these circumstances, providing finality, an end to the financial drain, the hope of a lower prison sentence, and/or the hope of a return of children to the other parent. These may be well considered decisions, where the best option of a bad set of options for an innocent person accused of abuse, may be to make false admissions.

These *pragmatic and/or incentivized admissions* are separate from, and in addition to, false confessions made under interrogation (although the line between the two types of false self-incrimination is often blurred, because pragmatic and incentivized motives can be used by police during interrogation to coerce false confessions, see below).

4.2. False confessions

As for false confessions during interrogation, we know that they occur, because there are many cases where DNA evidence has proven the innocence of people who have previously confessed to a crime [33]. Indeed, around 29% of people exonerated by DNA evidence had falsely confessed [34] to crimes that they did not commit.

Overall rates of false confession are not easy to determine. According to one self-report survey, police interrogators estimated that around 5% of innocent suspects provided a partial or complete confessions [35]. A study of youths who had been interrogated by police in Iceland found that 12% reported that they had falsely confessed [36]. Laboratory based studies indicate the rate of false confession rates could be significantly higher, in certain circumstances [37].

Significant research looking at such circumstances have highlighted the risk factors that can lead to false confessions. Many of these risk factors occur naturally in AHT cases, meaning that the rate of false confession in SBS/AHT may be significantly higher than in other cases.

One risk factor that applies with particular force in AHT cases is the highly emotional state of the parents or caregiver. For 58.0% of 93 respondents, the infant was still in hospital when the interview occurred, whilst for 18.2% their infant had died, and for 18.2% the infant had been removed from the family home. In only 5.4% of cases, the infant was with relatives whilst the accused person was interrogated. The Swedish study of twelve parents being accused also reported that interrogations took place when those being accused were in an emotional state, with

children having been removed. Research shows that emotionally vulnerable people are more susceptible to pressures to confess falsely [38].

Another risk factor occurs when the interrogator already believes that the accused is guilty. In AHT cases the interrogator, whether the doctor or a police officer, often believes the accused is guilty based on medical opinion. Research [39–41] has shown that interrogators who already presume guilt ask more incriminating questions, conduct more coercive interrogations, and try harder to get a confession. The more accusatory the interrogation, the greater the risk of a false confession.

The Reid technique is the quintessential example of an accusatorial interrogation. An important aspect is to confront the suspect with accusations of guilt, without providing an opportunity for denial, or for alternative explanation. The accused in an AHT case may be told that the infant suffered trauma, and may explain that the infant had an accident, only to be told that accidents cannot cause these medical findings. Indeed, the majority of people diagnosed with AHT point to an accident as a possible explanation [42], and these explanations are dismissed. Nearly 80% of those accused in France stated that they were told by investigators that the medical evidence for abuse was certain and irrefutable (see Fig. 1). Investigators are informed by the diagnosis of the doctors, and this is reinforced in France where protocols for AHT diagnosis state the AHT is "certain" when specific medical findings are found [43] and there is no history of major trauma or evidence for one of the three recognized differential diagnoses (Menkes disease, glutaric aciduria type 1, arteriovenous malformations). Police and justice take the certainty of the medical diagnosis for granted.

Similar certainty of abuse was also reported in the interrogations of those accused of AHT/SBS in Sweden, who were told "We know that you are 100% guilty", and that "You'd better confess now. All other possibilities but SBS are out ruled" [44]. The Swedish interrogations were described as harsh and brutal, with intense pressure and questioning.

In the Reid technique, interrogators also offer sympathy and moral justification, minimizing the crime and providing the accused a reason to believe that making a confession is an expedient means of escape. The opportunity to offer sympathy and to minimize comes naturally in AHT cases. Interrogators may say, "I know the pain you are in, you have lost your child" and make suggestions such as "we all know how frustrating it can be when the baby cries" or "you really didn't mean it any harm, you just shook it harder than you intended".

The combination of maximizing confrontation by refuting suspects' denials, and minimizing the appearance of moral culpability, both occur naturally in AHT cases without the need to deliberately or consciously employ coercive interrogation methods. The combination exploits a tendency in humans to over-value immediate rewards relative to future consequences [45].

The circumstances that surround accusations of AHT create essentially the perfect storm for eliciting false confessions.

A final red flag for false confessions is when details of the crime come from the interrogator, rather than the confessor. In AHT, one can ask who first suggested the mechanism of shaking? Was this detail provided by the doctors? The investigators? The interrogators? Or was it suggested by the admitter, without any accusations of shaking being made? Recording who provided that detail can help provide an assessment of the reliability of the admissions, and the level of risk of false confession.

Regarding the details of his confession, the interviewed father who claims to have falsely confessed stated that "One of the two detectives couldn't stop telling me it could happen to some parents to shake their child while telling them 'you need to eat now!'. I just had to repeat what they had told me, by "improving" the story a bit and giving a bit more details …" So "I said I shook her for one or 2 s, while telling her she needed to take her bottle."

4.3. Conflation of what was admitted

Finally, in confession-based studies of AHT, there is often a lack of information of what was actually admitted, and a risk of conflating radically different types of "confessions" [46]. In one case from an Australian study of confessions, the accused said that he often bounced the infant on his knee after feeding, causing her head to move 'up and down and back and forth.' [47] This was taken as an admission to shaking. Were these accused looking for the closest thing to shaking that he could think of, given that he had been assured by interrogators and doctors that the baby had been shaken?

Similarly in France in the case of Alexandre Chacón [48], an admission to rapidly taking an infant from a bed was taken to be a confession to shaking. During his police interrogation, Alexandre denied that he had ever abused his son and stated that he had never shaken him. A police officer then told Alexandre about a basketball player who had allegedly *"shaken"* his infant son without meaning to, due to movements caused when she rapidly pulled her son out of bed. Alexandre was reminded of a time when he also took his son *"very quickly"* out of his crib. Alexandre explained that he *"was screaming like a hungry baby. I took it quickly, I saw his head bobbing."* He explained that he was tired at the time and had "messed up" and that *"if … it caused these consequences … it is horrible if I killed my child."* Having subsequently learned of the violent nature of abusive shaking, and that lifting a child out of bed cannot cause these types of injuries, Alexandre strongly denies ever having shaken or abused his child. The French judicial system took Alexandre's comments as a confession. Acquitted in 2019 by a criminal court, the prosecution appealed and he was convicted to 5 years with probation in 2021 by the appeal court, primarily on the basis of his "confession".

In the survey of French people accused of AHT, 42 out of 97 respondents (43.3%) came to believe that mild and relatively innocuous gestures could have unintentionally caused the child's symptoms, either during or after the interrogations. In 13 cases (13.4%) from the survey, the courts and/or the police considered that the accused had made confessions, even though all respondents maintain their innocence.

4.4. Findings from judicial proceedings are being used to validate forensic science: the risk of circular reasoning

A danger of using admitted cases as a reference standard for AHT is the risk of circular reasoning. This can occur in a systematic manner when the diagnosis test is embedded within the investigative and judicial processes in which admissions are made. In other words, the first part of the process is the diagnosis by physicians or multidisciplinary teams, based on the very findings that are the subject of the diagnostic test, and during the next parts of the judicial process, the police and judiciary have been trained and/or informed by the physicians regarding these same findings.

There is a real risk that this circular feedback loop may have occurred in France. In 2010, Adamsbaum et al. stated that "confessions are uncommon in abusive head trauma (AHT)". The codification in France of protocols for the diagnosis of AHT in 2011, their validation by the Haute Autorité de Sante in 2017, and subsequent incorporation into the policing guidelines [49], and into judicial decision making [50], has made it increasingly difficult to fight these charges of AHT, once certain findings (those associated with AHT) are present. The systematic application of these diagnostic methods within the medico-judicial system risks creating a circumstance where conviction becomes increasingly likely, meaning that admissions become increasingly pragmatic and risk factors for false confessions become heightened.

By 2022, Vinchon et al. [51] claim that, rather than being "uncommon" as they were prior to 2010, 37% of the cases result in admissions. The authors state that they believe the admissions are made "in order to relieve their conscience". Perhaps the French people have dramatically increased their level of relieving their guilty conscience since 2010, such that admissions went from uncommon to a high rate. However, a rapidly evolving conscience in the French population seems unlikely, considering that dramatic increases in confessions are not occurring for other offenses. Another explanation is that admissions have become

increasingly pragmatic as the prospect of conviction and/or child removal has increased, along with the associated increased emotional and financial burdens. On top of this, the increased certainty of interrogators, and refusal to listen to an explanation that does not involve abuse, adds significant psychological pressure to the accused, in a manner that research has shown to increase risk of false confessions (as discussed in Section 4.2 above), with the accused feeling hopeless and powerless.

Looking at this from another angle, the admissions in almost all confession studies, not just the French ones, are made after the diagnosis of AHT by physicians and during the investigative and/or judicial proceedings, not spontaneously. The one exception [52], a study that used only spontaneous admissions or independently witnessed AHT, made radically different findings than the other studies. The researchers who use admissions made after the diagnosis of AHT are incorporating investigative and judicial decision making (which are guided by the diagnostic test) into their reference standard. Yet this is the very research that is supposed to guide and advise the investigative and judicial processes. By using admissions made during the investigative and judicial process, the experts who are tasked with informing and educating the investigators are using the findings of the investigative and judicial processes to validate their theories. The tail is wagging the dog.

The only way to break the potential for a circular, self-fulfilling prophecy is to use a more reliable, independent reference standard, such as independently witnessed events and/or confessions that are spontaneous.

5. Conclusions

The results of a survey of French parents who have been accused of AHT highlight a range of concerns with using admitted AHT as a reference standard for validating the methods used to diagnose AHT. As well as plea bargains, there are multiple other reasons to question the reliability of admissions to AHT, including the promise of (or hope of) reduced sentences; the promise of (or desire for) the return children to the family home (to at least one parent); a desire to stop accusations being leveled at a partner; a desire for legal proceedings to end, and certainty to return. These factors must be considered in the context of expensive and stressful legal proceedings that are drawn out over years, leading to depression and financial hardship, and that seem to be inevitably heading towards conviction, given the qualifications and influence of the medical experts who will testify for the well-funded state.

We have argued that this mix may lead to the accused making *pragmatic* and/or *incentivized* admissions, where making admissions can be considered as the least bad option. Out of 97 respondents, 11.3% stated that they had made false admissions for pragmatic reasons.

Further, the survey highlights the problem of including admissions to acts that are lesser than violent shaking, with police and/or investigators asserting that admissions were made in 13.4% of surveyed cases, despite the accused maintaining their innocence.

In *addition to* pragmatic/incentivized admissions and admissions to acts that are lesser than violent shaking, false confessions are real, and major risk factors for false confessions evolve organically in AHT investigations. Such risk factors include investigators believing in guilt (due to medical opinion), leading to more accusatory interrogations, the dismissal of suggested causes such as falls, the portrayal of certainty that AHT has occurred and that the accused is left with no other option and is hopeless, and the possibility to simultaneously minimize and provide sympathy for a parent who has supposedly been frustrated by a crying baby [53,54]. The Adikia survey confirms that such risk factors for false confessions are present within the French investigative and judicial system.

All the studies of AHT that have adopted admissions as a reference standard are made during the investigative and/or judicial phase, so *after* physicians have diagnosed abuse based on the findings that are widely believed to be associated with AHT (most prominently encephalopathy, Subdural Haemorrhages, and extensive Retinal Haemorrhages). Thus, the findings in such cases *must* correspond to the findings that are widely believed to be associated with AHT. When establishing admitted cases as a reference standard, the first step is the diagnosis of physicians. In other words, the diagnostic test is incorporated into the reference test. This introduces the risk of bias, and of circular reasoning.

When admissions are pragmatic, incentivized, and/or false, circular reasoning can become systematically embedded into the investigative and judicial processes. Circularity is created when studies based on admissions are used to establish and increase the perceived certainty of the diagnosis of AHT, leading to increasing certainty of the investigators and increasing hopelessness of the position of the accused, leading to an increased number of pragmatic/incentivized/false admissions, leading again to further increase in perceived certainty in the diagnosis. And so the cycle continues.

One must ask how reliable are these admissions that occur during the investigative and judicial process, if one wishes to use admitted cases as a reference standard in a scientific study. Given the potential problems raised in this survey, and the lack of information provided in confession based studies to date, we conclude that when admissions are made subsequent to the diagnosis of physicians, they fail to overcome the risk of circularity, and that such admissions are not a reliable reference standard for AHT. Admissions made *prior to* any diagnosis of AHT (a diagnosis that relied upon findings associated with the diagnostic test that is being studied) would make a more reliable reference standard [55].

In order to properly understand the accuracy of diagnosis methods for AHT, a reliable reference standard is required. Such a reference standard is best made from spontaneous confessions (made prior to physician diagnosis) and/or unbiased, independently witnessed events.

Author Contribution

This is a co-first author article, where both authors contributed equal amounts. **Cyrille Rossant** planned and conducted the survey, contributed conceptualization, reviewed and edited the text; **Chris Brook** wrote the manuscript, and contributed conceptualization.

Declarations of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.fsisyn.2022.100312.

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