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## A part-declared blind testing program in firearms examination

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### ABSTRACT

In 2015 and 2016 the Central Unit of the Dutch National Police created and submitted 21 cartridge case comparison tests as real cases to the Netherlands Forensic Institute (NFI), under supervision of the University of Twente (UT). A total of 53 conclusions were drawn in these 21 tests. For 31 conclusions the underlying ground truth was “positive”, in the sense that it addressed a cluster of cartridge cases that was fired from the same firearm. For 22 conclusions the ground truth was “negative”, in the sense that the cartridge cases were fired from different firearms. In none of the conclusions, resulting from examinations under casework conditions, misleading evidence was reported. All conclusions supported the hypothesis reflecting the ground truth. This article discusses the design and results of the tests in more detail.

### 1. Introduction

Modern firearms fire cartridges, each one typically consisting of a projectile (bullet), propellant (powder charge), and igniter (primer) held together by a cartridge case. Most modern firearms are automatic and/or semi-automatic. When a cartridge is fired in such a firearm, the bullet is fired at the target through the barrel and the cartridge case is expelled from the firearm. The firearm typically marks the bullet and the cartridge case with striations or impressions. The distribution, shape and size of these striations and impressions may vary per individual firearm. Comparing these marks with a comparison microscope can give information on the question whether two or more cartridge cases or bullets were fired from the same firearm or whether they were fired from a specific firearm. This type of examination is referred to as e.g. ‘cartridge case and bullet comparison’, ‘forensic firearms examination’, and ‘forensic firearm identification’ in the literature [1]. This discipline is a feature-comparison method from which the validity has been critically highlighted in the 2009 NAS-report [2] and in the 2016 PCAST-report [3].

Periodic “blind” testing of examiners can help to assess the validity of conclusions drawn from cartridge case and bullet comparisons. It also offers the possibility to provide feedback to examiners working under casework conditions. “Blind”, “double blind”, “declared double-blind” and “external blind” testing has been referred to in various ways

in the literature [3–13]. Kerkhoff et al. [4] and Stoel et al. [5] have used the term “double blind” to denote studies in which examiners were not aware that they were being tested. In medical science, the term double blind is well established for clinical trials where both the tested subjects and the personnel administering the test samples have no knowledge of the test design, e.g. in the sense that both do not know which sample e.g. contains the tested drug or a placebo. In line with this definition, the term double blind has been used in forensic literature concerning firearms examination by Smith et al. [6], Stroman [7], and Bunch and Murphy [8] to denote studies in which both the tested firearms examiners and the administrators of the tests had no way of knowing the correct outcome of the tests. Another feature of these three studies was that extra care was taken to make the tests as realistic as possible. To distinguish her study from other studies where the tested examiners were not aware that they were being tested, Stroman [7] labelled her study a ‘declared double blind’ test. In the current study, as in the earlier one by Kerkhoff et al. [4] (then labelled a “double-blind” study) the tested examiners knew they could be tested but did not know whether or not they were working on a test or a real case at the time of examination. To distinguish the current study from the studies by Smith et al. [6], Stroman [7], and Bunch and Murphy [8], and building on the definition used by Stroman, the tests deployed in the current study will be labelled “part-declared blind” tests. This type of test is defined here as a test where the tested examiner does not know the ground truth of

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the test, knows that he or she can be tested, but does not know whether or when he or she is actually working on a test or on a real case. The police agencies that served as administrators of the tests knew the ground truth of the tests. The “ground truth” is defined here, following the SWGFAST [14] definition, as ‘definite knowledge of the actual source of cartridge cases and bullets’, and is used for instance by Thompson et al. [15] in this sense. Contact between the administrators of the tests and the tested examiners was limited to the examiner receiving a written request to examine the submitted evidence and the administrator receiving a written report in return, as in real cases. The current study was publically announced in advance via a Letter to the Editor in *Science & Justice* by Stoel et al. [5], then still referring to “double-blind” tests. With the announcement, the authors wanted to express their commitment to publish their results, regardless of the outcome. This was done in order to prevent the possible future problem of publication bias, that would arise when unfavourable results from the current and similar studies would not be published. In that event, an analysis of published results will be biased because it will only include the more favourable results.

## 2. Study design and set-up

### 2.1. Improvements on the earlier study

The current study was built on the experiences from an exploratory study [4], conducted in 2010, 2011, and 2012. In this exploratory study, 10 cartridge case and bullet comparison tests were prepared and submitted by various police agencies as regular cases to the NFI under supervision of the University of Amsterdam (UvA). The results of the tests were evaluated with the VU University Amsterdam (VUA). A total of 29 conclusions were drawn in the 10 tests. For 19 conclusions the ground truth was “positive”, in the sense that the submitted cartridge cases or bullets were either fired from the questioned firearm or from one and the same firearm (in tests where no firearm was submitted). For 10 conclusions the underlying ground truth was “negative”. In none of the conclusions misleading evidence was reported, in the sense that all conclusions supported the hypothesis reflecting the ground truth. The current study included more tests which resulted in more conclusions. In contrast with the exploratory study, a choice was made to focus on a single case type and a single evidence type. The blinding was improved by involving only one of the NFI's firearms examiners in planning the study, instead of the three that were involved in the exploratory study. The blinding was further improved by sending in tests through an unsuspected source, as will be explained in Section 2.4. Last, a more in depth assessment of the effectivity of the blinding procedure was performed.

### 2.2. Case type

The case type selected for the current study typically consists of ammunition parts (bullets or cartridge cases) from minor incidents (e.g. vandalism) without victims or suspects. The submitting agencies request to enter the ammunition parts in the open case file, to be able to link the exhibits to other incidents or test fires from firearms. Before entering the ammunition parts into the open case file, a short, indicative examination is performed to establish whether the ammunition parts were fired from one or more firearms. With cartridge cases, the examiner typically selects and compares the most prominent of the marks with the highest evidential strength and only checks whether the other marks are not inexplicably different. The conclusion of the comparison is reported. The examiner notes that “the results indicate that” the ammunition parts were fired from one firearm, if applicable. If ammunition parts from more than one firearm are received, the number of firearms used and the number of ammunition parts per firearm is reported. Being an indicative examination type, a complete assessment and interpretation of the evidence followed by a conclusion in the form

of a likelihood ratio, which is the standard at the NFI in other case types, is not carried out.

### 2.3. Test scope

For creating the tests, 9 mm Luger cartridge cases from 39 Glock pistols and one SIG pistol were selected. Firearms of this calibre are at present the most commonly used ones in shooting incidents in the Netherlands. Apart from an indicative statement about the number of firearms that were used, the type of the used firearm(s), and whether these firearms were used in crimes in the Netherlands is also reported. The assessment of the correctness of the latter two statements was left out of scope in the current study. None of the tests were set-up in such a way that a “hit” in the open case file should be found. Consequently (and “correctly”<sup>1</sup>) no hits in the open case file were reported.

### 2.4. Test preparation and routing

The tests were prepared and distributed by a member of the Central Unit of the Dutch National Police. The aforementioned 40 pistols were used to fire 137 cartridges. A wide variety of ammunition brands with different headstamps was used, as this is commonly encountered in casework in the Netherlands. The 137 cartridge cases (the fired bullets were not collected) were distributed over 21 test sets. See Table 1 for an overview of the test sets.

Pistol P25, used to prepare test T14, was a SIG pistol. All other pistols were Glock pistols. The cartridge cases with DAG and S&B headstamps were of several varieties (various production years and/or lots, with and without lacquer etc.). Several of the cartridges were corroded with salt water and/or by prolonged atmospheric exposure and some cartridge cases were deliberately damaged (e.g. by being driven over with a vehicle) to mimic casework conditions. Notes were kept on the number of cartridge cases, their headstamps and the firearm (s) they were fired from, for all tests. The sets per test were not selected by their marks. In this way a bias towards either “hard” or “easy” comparisons was prevented. After preparation, the test sets were distributed over various police agencies and submitted as real cases to the NFI within a two year time frame. Eight test sets were submitted as though they were submitted from the Caribbean islands of Bonaire and St. Maarten. The Netherlands has ties with these islands through various constitutional structures. Due to the geographical distance and the difference in time zones, contact between the NFI and Caribbean police agencies is less frequent than for agencies located in The Netherlands. The more independent island of St. Maarten submits its cases to the NFI as a paying customer. For the tests sent in as coming from St. Maarten, a mock signed invoice was prepared and submitted in advance, and approved by uninformed NFI employees. Because of the aforementioned procedure we expected that cases from Caribbean islands would not be believed to be tests by the firearms examiners.

### 2.5. Monitoring the blinding

Apart from the public announcement [5] mentioned in the introduction, the examiners of the NFI's Firearms Section were verbally notified of the study. They were told that an unknown number of blind tests could be expected from every possible source for an unrevealed period in time. No further information was given. A questionnaire was appended to all cases (tests and real cases) during the course of the study. The questionnaires were filled out by the examiners after completing each case, stating whether or not they believed the case was a

<sup>1</sup> Strictly speaking, the ground truth of not finding a hit in the open case file with these tests is not known. The Glock pistols that were used for this study were borrowed from a well-guarded naval depot. The chance that any of these pistols were used in a crime is considered to be very low, but it cannot be ruled out completely.

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