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Transfer of picked-up DNA to cotton plates

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ABSTRACT

DNA is readily transferred to a knife handle by hands during a stabbing action and DNA existing on the handled knife-handle is readily picked-up during the action and transferred to a subsequently handled object. We repeated a part of an earlier study where instead of placing a handprint on five DNA-free glass plates post handling of a knife-handle, participants placed handprints on five consecutive cotton plates. Less DNA was collected from the cotton plates than from the glass plates. This appears to be due to less efficient recovery from cotton plates. DNA from the previous handler(s) of the knife was observable on some subsequently touched cotton plates. Sometimes not on the initially touched plates but on those touched later in the sequence, pointing to potential impacts of different manners of contact. The proportion of this relative to the depositor's DNA was on average < 10%. Where there were multiple previous handlers of the knife, DNA of the most recent handler(s) tended to be more prominent than earlier handlers, within the profiles derived from the cotton plates. As per prints left on glass plates, the total and transferred amounts of DNA tended to decrease as more cotton plates were touched subsequent to picking-up foreign DNA from previously touched knife handles. The substrate of the item contacted impacts on the yield and detectability of transferred DNA. More studies are required to increase our understanding of the impacts different substrates have on DNA transfer, persistence, prevalence and recovery.

1. Introduction

DNA is readily transferred to a knife handle by hands during a stabbing action and DNA existing on the handled knife-handle is readily picked-up during the action and transferred to a subsequently handled object [1–3]. Buckingham et al. [1] also showed that the profiles of later handlers of a knife are more prominent than earlier handlers, that proportional contributions to profiles retrieved from knife handles vary depending on the individuals touching the knife handle, and that the quantity of foreign DNA picked up by a hand and deposited on subsequently touched objects diminishes as more DNA-free objects are handled soon after each other. The DNA-free objects used in the reported study were glass plates. Here we report on a small investigation where the study by Buckingham et al. [1] was repeated using glass plates covered with cotton fabric (soft, porous) rather than glass plates (hard, nonporous) and consider the impact on yield and profile of DNA collected from the cotton compared to those collected from glass plates.

This brief report is intended to add to our knowledge on DNA transfer, persistence, prevalence and recovery of DNA (DNA-TPPR).

2. Materials and methods

The experimental process was as described in Buckingham et al. [1] where each of four individuals rubbed their hands, immediately placed a left-handprint on a glass plate allocated to each individual, and handled a knife in a prescribed manner, with their right-hand, after each other, followed by each individual immediately placing a right-handprint on each of two or five glass plates allocated to each individual. However instead of touching glass plates cotton plates were touched. This test was performed twice.

The fabric used to cover the glass plates was 100% cotton sourced from a middle section of a large new roll whilst wearing mask and gloves. Each side was exposed to 1 h ultraviolet light prior to placement onto a pre-cleaned glass plate. Negative control samples were taken from a replicate of each of the two cotton sheets covering a glass plate and processed to check their DNA-free status. All negative controls were found to be DNA-free.

Samples were collected from the cotton employing the wet/dry double swabbing technique using cotton swabs, then processed plus data analysed as described in Buckingham et al. [1].

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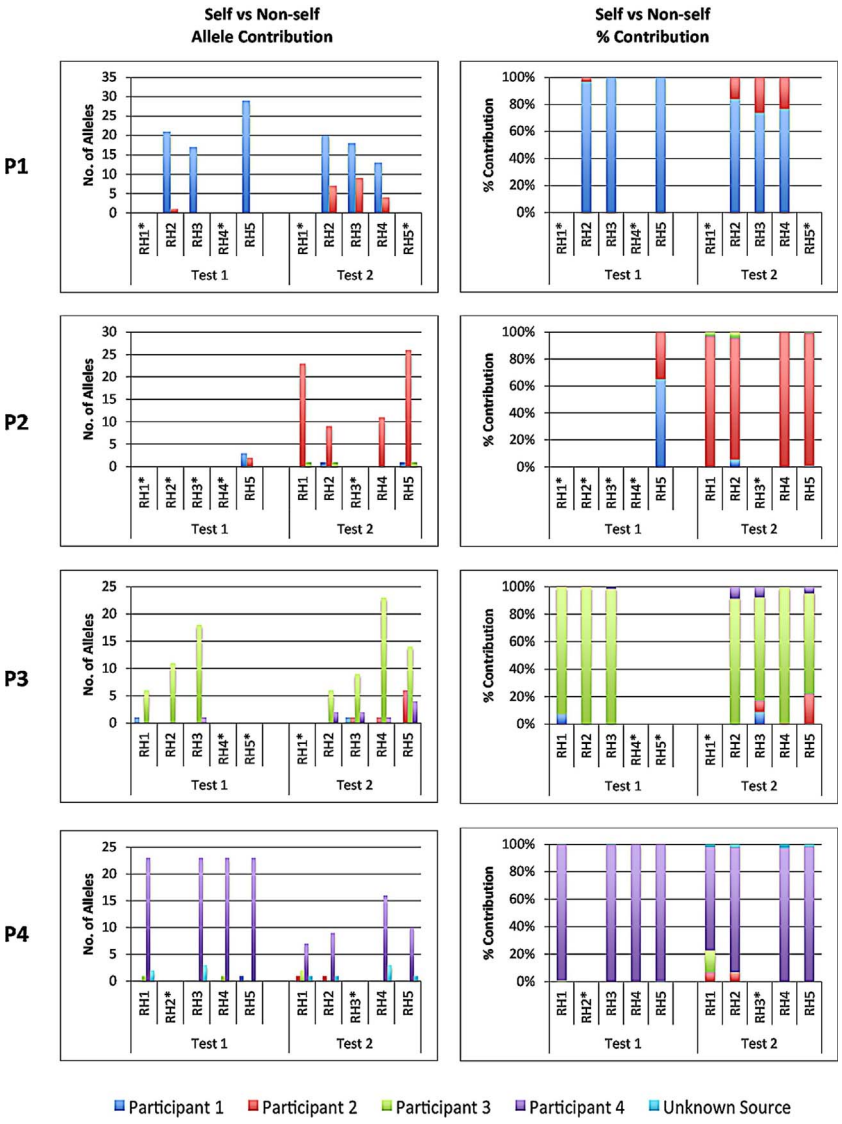

Fig. 1. Each participant's self and non-self allele contribution (A) and relative peakheight (RFUs) contributions (B) to the first (RH1) to the fifth (RH5) right handprints in each test, with non-self portion broken down into known contributors (other participants within the test set) and unknown sources. * = No result.

3. Results

The two knife handles, each handled by four individuals, provided no less DNA than, and profile compositions commensurate with, those of the previous study [1]. However, significantly less DNA was collected from the cotton plates (left handprints prior to touching knife: average 0.86 ng, SD 0.79; first right handprint on plate post knife handling: average of 2.97 ng, SD 0.71; second right handprint on plate post knife handling: average of 2.49 ng, SD 0.58), than from the glass plates in previous study [1] (left handprint average 0.83 ng, SD 1.30; first right handprint post knife handling: average of 17.76 ng, SD 0.88; second right handprint post knife handling: average of 9.8 ng, SD 0.6).

Fig. 1 shows the self and non-self allele and relative peakheight contributions to the five cotton plates per participant in the two tests performed. Of the 40 samples of handprints left on cotton plates after handling a knife handle (that for participates 2–4 within each set had been handled by 1–3 known individuals), just prior to placing the handprint on the cotton plates, only 65% produced full or partial DNA profiles (Fig. 1). The total RFU of the full profiles were lower than those retrieved from deposits on glass plates. These results imply that either less DNA was transferred to the cotton than glass plates and/or DNA was not as effectively recovered from the cotton as from glass.

DNA from the previous handler(s) of the knife was observable on some subsequently touched cotton plates (Fig. 1). Sometimes not on initially touched plates but on those touched later, implying potential impacts of different manners of contact. The proportion of this relative to the depositor's DNA was on average < 10% (Fig. 1). Where there were multiple previous handlers of the knife, DNA of the most recent handler(s) tended to be more prominent than earlier handlers, within the profiles derived from the cotton plates (Fig. 1). As per prints left on glass plates, the total and transferred amounts of DNA tended to decrease as more cotton plates were touched subsequent to picking-up foreign DNA from previously touched knife handles.

4. Discussion

The results are consistent with several studies demonstrating that foreign DNA can be readily picked-up by a hand (or object) when contacting a previously handled object (or another person's hand) and transfer it to subsequently handled (or contacted) objects [including 1–8], as well as the study by Buckingham et al. [1] showing that the profiles of the later handlers of a knife are more prominent than earlier handlers in samples retrieved from subsequently handled objects, and that the quantity of foreign DNA picked up by a hand and deposited on subsequently touched objects diminishes as more DNA-free objects are handled soon after each other. However, whilst the results are few, they indicate that slight differences in the manner of a one-off contact may impact the amount deposited. This study also demonstrates that the

detectability of directly and indirectly transferred DNA appears dependent on the type of substrate contacted and/or how the DNA is retrieved from it.

The lower levels of retrieved DNA from the cotton substrates compared to those retrieved from the glass plates is likely to be due to porosity of the cotton substrate. The weave may have allowed DNA containing material to traverse through the cotton and settle on the underlying glass plate, and/or be bound within the fabric matrix, that did not facilitate efficient collecting using the swabbing method applied [9–11].

5. Conclusions

The substrate of the item contacted impacts the yield and detectability of transferred DNA. More studies are required to increase our understanding of the impacts different substrates have on DNA-TPPR.

Conflict of interest statement

None.

References

[1] A.K. Buckingham, M. Harvey, R.A.H. van Oorschot, The origin of unknown source DNA from touched objects, Forensic Sci. Int.: Genet. 25 (2016) 26–33.
[2] L. Samie, T. Hicks, V. Castella, et al., Stabbing simulations and DNA transfer, Forensic Sci. Int.: Genet. 22 (2016) 73–80.
[3] G.E. Meakin, E.M. Butcher, R.A.H. van Oorschot, et al., Trace DNA evidence dynamics: an investigation into the deposition and persistence of directly- and indirectly-transferred DNA on regularly-used knives, Forensic Sci. Int.: Genet. 29 (2017) 38–47.
[4] C.M. Cale, M.E. Earll, K.E. Latham, et al., Could secondary DNA transfer falsely place someone at the scene of a crime? J. Forensic Sci. 61 (2016) 196–203.
[5] V.J. Lehmann, R.J. Mitchell, K.N. Ballantyne, et al., Following the transfer of DNA: how does the presence of background DNA affect the transfer and detection of a target source of DNA? Forensic Sci. Int.: Genet. 19 (2015) 68–75.
[6] A.E. Fonnelop, T. Egeland, P. Gill, Secondary and subsequent DNA transfer during criminal investigation, Forensic Sci. Int. Genet. 17 (2015) 155–162.
[7] M. Goray, R.A.H. van Oorschot, The complexities of DNA transfer during a social setting, Legal Med. 17 (2015) 82–91.
[8] B. Szkuta, K.N. Ballantyne, R.A.H. van Oorschot, Transfer and persistence of DNA on the hands and the influence of activities performed, Forensic Sci. Int.: Genet. 28 (2017) 10–20.
[9] T.J. Verdon, R.J. Mitchell, R.A.H. van Oorschot, Preliminary investigation of different tapelifting for sampling forensically relevant layered deposits, Legal Med. 17 (2015) 553–559.
[10] T.J. Verdon, R.J. Mitchell, R.A.H. van Oorschot, Evaluation of tapelifting as a collection method for touch DNA, Forensic Sci. Int.: Genet. 8 (2014) 179–186.
[11] T.J. Verdon, R.J. Mitchell, R.A.H. van Oorschot, The influence of substrate on DNA transfer and extraction efficiency, Forensic Sci. Int.: Genet. 7 (1) (2013) 167–175.