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DNA on the inside door handles of entrance doors

Colin Charles Tièche [a], Markus Dubach [b], Martin Zieger [a,*]

[a] Institute of Forensic Medicine, Forensic Molecular Biology Department, University of Bern, Murtenstrasse 26, 3008 Bern, Switzerland
[b] Bern Cantonal Police, Nordring 30, 3001 Bern, Switzerland

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ABSTRACT

DNA from door handles on entry doors could provide a clue as to who last left the scene. However, after years of extensive research on DNA transfer and persistence it can be considered common knowledge that general claims like "the last who touched leaves the most DNA" do not hold true. But who's DNA do we find on door handles that are usually used several times per day by the inhabitants? To assess this question, we sampled inside door handles from real-life burglaries and at the same time collected reference samples from all the inhabitants, to determine if we can detect any (major) profiles from non-inhabitants. We also searched to evaluate how often we detect DNA from the person who last touched the door handle as a (major) contributor. Only small amounts of DNA were recovered from the handles, originating most often, but not always, from inhabitants or even the last inhabitant touching the handle.

1. Introduction

Given the high variability of possible DNA transfer scenarios, peers are united in their call for more science in the field [1,2]. In several forensic scenarios it may become relevant to assess the question of who was the last to leave the scene of a crime in an apartment. Sampling door handles from entrance doors seems like an obvious approach here. However, intuitively we would expect an excess of DNA from residents, touching the door handles several times a day. The current study aimed at shedding some light on the questions of how much and who's DNA can be found on inner door handles.

2. Study design

Inner door handles and buccal swabs from all residents were sampled in burglary cases in private households in Switzerland, between November 2020 and April 2021. DNA profiles were established with AmpFlSTR® NGMSelect™ and NGMDetect™ Kits (Thermo Fisher, Waltham, MA, USA). See Tièche et al. [3] for more details on the sampling procedure and the sample processing. STRmix™ v2.9 [4] was used for mixture deconvolution and probabilistic genotyping. Number of contributors (NoC) was determined by maximum allele count. Major components were determined from STRmix deconvolution as all fractions amounting to > 50 % of the total DNA amount. According to Swiss database submission criteria, CODIS-suitable profiles are all profiles with ≥ 6 (single) or ≥ 8 (two-person-mixture) typed loci, confirmed by a replicate PCR amplification. For major components to be considered CODIS-suitable single profiles, heterozygote peak balance of > 60 % and mixture ratio $> 3{:}1$ are required, according to lab internal quality guidelines.

3. Results

In total, we collected DNA traces from inner door handles in 52 burglaries. In 39 cases, we obtained reference samples from all residents. Of those 39 samples, 38 contained less than 4 ng DNA in total (Fig. 1). DNA profiles could be established for 35 of them. In 22 (63 %) of the traces from inner door handles, the major component corresponded to the last contact, eight times (23 %) to another inhabitant and five (15 %) major profiles were from unknowns. It has to be mentioned that in eight cases, the last contact was also the only resident. For two samples, the last contact with the handle was the police officer. However, both samples showed a major profile from a resident. We classified 16 of the 35 profiles as CODIS-suitable majors. The proportions of the different major contributors for CODIS-suitable profiles were similar to the ones determined by STRmix, with 11 profiles (69 %) corresponding to the last contact, three (19 %) to other residents and two (13 %) to unknowns. On average, two residents lived in one apartment. The mean NoC was 2.9. Thus, on average, one person more than residents was needed to explain the DNA results. Unified likelihood ratios (LRs) for all residents were

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* Corresponding author.
E-mail address: martin.zieger@irm.unibe.ch (M. Zieger).

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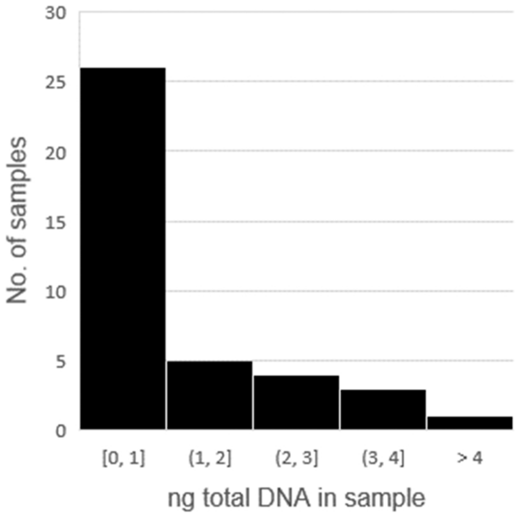

Fig. 1. Distribution of total DNA amounts for all 39 samples.

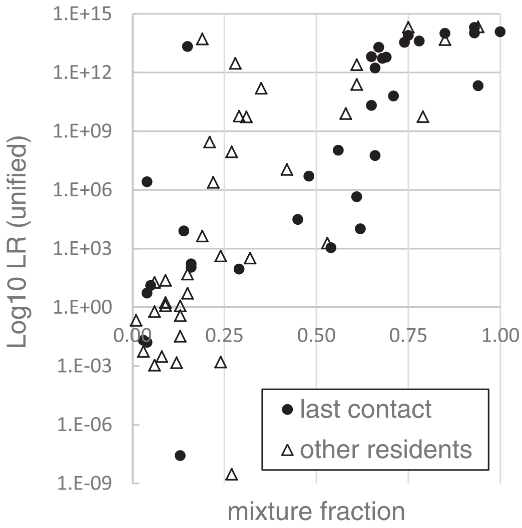

Fig. 2. Log10-LRs for 70 residents as contributors to 35 profiles.

calculated (Fig. 2). The LR was > 1 for 81 %, > 1000 for 61 % and > 1 million for 51 % of the 70 residents.

4. Discussion and conclusions

Even though door handles of apartment entrance doors are touched several times a day by the inhabitants, they apparently only bear small amounts of human DNA. Our results demonstrate that most profiles from door handles are from inhabitants, more than half of them from the last person who touched the handle. However, we still detect more than 10 % of major components originating from unknown individuals. These could be caused e.g. by visitors or, since we investigated real casework samples for the present study, from the perpetrator touching the handle. Alternatively, they could also result from secondary transfer. Indeed, in four out of five cases when the major contributor was unknown, the residents received at least one visitor within the last seven days before the burglary. Setting a threshold of LR = 1000 to assume contribution, 43 of the 70 residents could be detected on the door handles. However, for all profiles taken together, we detected DNA from around 100 individuals. Therefore, DNA from a significant number of unknowns must be present, albeit apparently rarely as a major component.

Ethics Statement

The study does not fall under the scope of the Swiss Federal Act on Research involving Human Beings. No identifiable personal data has been used for this publication. Written informed consent was obtained from all reference persons.

Conflict of Interest Statement

The authors declare no conflict of interest.

Acknowledgements

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