



The complexities of DNA transfer during a social setting

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ABSTRACT

When questions relating to how a touch DNA sample from a specific individual got to where it was sampled from, one has limited data available to provide an assessment on the likelihood of specific transfer events within a proposed scenario. This data is mainly related to the impact of some key variables affecting transfer that are derived from structured experiments. Here we consider the effects of unstructured social interactions on the transfer of touch DNA. Unscripted social exchanges of three individuals having a drink together while sitting at a table were video recorded and DNA samples were collected and profiled from all relevant items touched during each sitting. Attempts were made to analyze when and how DNA was transferred from one object to another. The analyses demonstrate that simple minor everyday interactions involving only a few items in some instances lead to detectable DNA being transferred among individuals and objects without them having contacted each other through secondary and further transfer. Transfer was also observed to be bi-directional. Furthermore, DNA of unknown source on hands or objects can be transferred and interfere with the interpretation of profiles generated from targeted touched surfaces. This study provides further insight into the transfer of DNA that may be useful when considering the likelihood of alternate scenarios of how a DNA sample got to where it was found.

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1. Introduction

In recent years the forensic community has seen a number of significant improvements in the field of forensic DNA. One of these is the ever decreasing quantities of target DNA that can now be detected and successfully amplified to generate profiles [1]. Often, there is no dispute to the identity of the individual from whom the DNA in question has originated, yet the mode by which the DNA got to where it was collected from is frequently questioned. Scenarios incorporating multiple DNA transfer steps, rather than direct transfer, are increasingly being raised in court as potential means for the presence of the defendants DNA at the crime scene or on a piece of evidence. This has prompted several investigations into DNA transfer under very controlled and semi-controlled conditions [2–15]; however little is published about DNA transfer in “uncontrolled” or real life situations. The benefit of conducting controlled experiments is that it allows for the impact of specific variables to be investigated independently. However, the added effects of other, unknown variables and all their interactions will also impact transfer outcomes. Whilst utilizing general information on the effects of specific variables to predict the likelihood of DNA being transferred in particular situations can be helpful, the resultant picture could be over-simplified and potentially

result in miss-representation of the results in court when estimating transfer possibility. There is thus a need to evaluate DNA transfer in a more holistic manner.

Two or more individuals coming together and communicating forms the basis of any social interaction and, thus, is one of the most common situations in which DNA is transferred. Here we focus on a small social everyday setting incorporating three participants sitting at a table sharing a drink (one central jug and individual glasses) over a 20 min period. We examine the effects of multiple direct and indirect transfer of DNA amongst this small group of people and objects. This was facilitated by video recordings of all interactions, in combination with the DNA results obtained, so that the occurrence or lack thereof, of specific sources of DNA from test surfaces collected post sitting could be effectively interpreted. Preliminary results of a subset of these tests were presented previously within conference proceedings [16] and here we present a fuller analysis of an extended investigation as well as provide the [supporting data](#).

2. Materials and methods

2.1. Experimental design

Three individuals participated in a social interaction of having a drink of juice together for the duration of 20 min. Participants were

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invited to have a drink and chat while participating in a blind experiment that was going to be video recorded. Participants were invited to take a seat; however the seats were not allocated but chosen at random by the participants. The participants sat on chairs with plastic armrests around a table and drank from individual glasses while using a communal jug filled with juice. The interactions were unscripted and participants were not informed about the specific aims of the experiment. The participants did not wash their hands prior to the experiment. All the interactions by the participants during the experiments were recorded with two video cameras and the duration and sequence of person to person, person to object and object to object contacts were analyzed. The experiment was repeated five times, each time with a different set of participants.

2.2. Experiment preparation and sample collection

A new set of glasses were cleaned and used for each experiment; the table, chair armrests and jug were cleaned prior to and re-used for each experiment. All relevant surfaces were cleaned as per laboratory procedures. In the first experiment, 0.05% hypochlorite and 70% ethanol were used; whereas 1% hypochlorite and 70% ethanol were used in all subsequent experiments. The change was due to the implementation of new laboratory operating procedures triggered by the introduction into routine casework of the more sensitive DNA profiling system Power Plex 21 (Promega) [17]. Additionally, all the glasses and the jug were exposed to UV light for 2 h post-cleaning.

Control samples were taken from the segments of the table, top of chair arms, entire jug and glasses prior to each experiment.

At the completion of each experiment, samples were taken from the segments of the table, chair arms (top only), jug handle, the remaining surface of the jug, entire outer surface of the glasses and the left and right hands of each participant using the wet and dry double swabbing technique (Coplan cotton swabs). Participants were informed that hand samples were to be taken after the experiment completion. The table was divided into six segments, with the two areas (left and right) in front and nearest to each of the three participants allocated to them (Fig. 1); all segments were sampled separately. The hand swabs were not taken from participants after Experiment 1.

2.3. Saliva test

To evaluate possible contributions of saliva derived DNA to the samples collected, due to participants speaking over the test surfaces and items, and its impact on the interpretation of DNA results, the experiment was repeated a sixth time. On this occasion all experimental surfaces were sampled pre- and post- sitting and tested for presence of saliva using Rapid Stain Identification of Human Saliva or RSID™-Saliva (Independent Forensics) as per manufacturer's instructions.

2.4. Videoing

Two video cameras were positioned such that all interactions could be readily observed. Each camera was set-up to record from

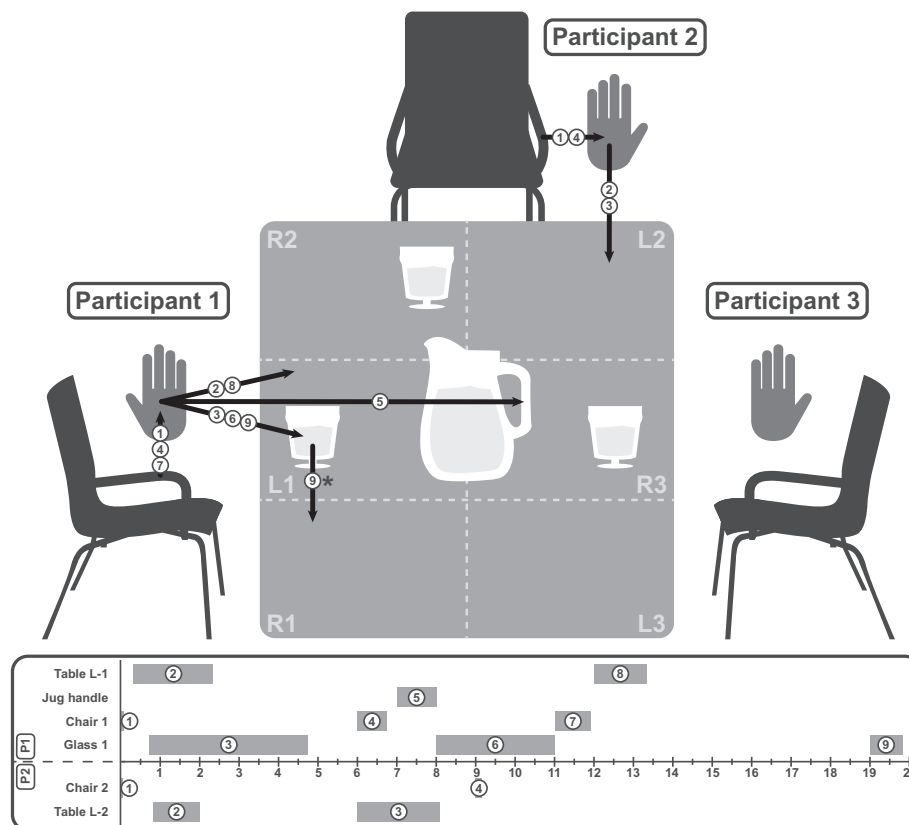


Fig. 1. Movements of unknown profiles A (related to Participant 1) and B (related to Participant 2) in Experiment 1 via the contacts made by the participants with associated tested surfaces (with arrows indicating the contacts made and the sequence of the contacts numbered) (Section 3.2.8). Note: arrows and associate actions identify contacts that may have led to DNA transfer; not all actions and contacts are depicted in this figure and further information regarding all of the actions and contacts by all of the participants is available in the [Supplementary Table 1](#). *During action 9, Participant 1 touched the underside of the glass and then placed it onto the right segment of the table. This is the most likely means of how the unknown profile A arrived on the right segment of the table.

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