



## Activities between activities of focus—Relevant when assessing DNA transfer probabilities



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### ABSTRACT

Consideration of the indirect transfer of 'touch DNA' is increasingly becoming part of criminal investigations. Focus is often concentrated on the actions relating to the pick-up of the relevant DNA and key actions associated with transfer to the exhibit from which the sample in question was collected. There is often a time lapse between such actions. As any contact can influence the gain and/or loss of DNA, it is relevant to have an awareness of what hands touch during everyday activities in order to assist consideration of what may be occurring during potential time lapses within contemplated scenarios. To gain an appreciation of the manner and frequency of hands contacting various surfaces during everyday activities, we analysed several videos of individuals performing a variety of general activities. The findings indicate that several items are touched over a relatively short period of time. Appreciation and consideration of general activities that may have occurred between key focus activities are necessary to assess any impact these may have on what is deposited at the final collection site. The information this provides is imperative when weighting alternative transfer scenario propositions.

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### 1. Introduction

Consideration of the likelihood of various indirect transfer scenarios occurring, as opposed to direct transfer scenarios, is increasingly requested in case deliberations. Such deliberations regarding indirect transfer often focus on the initial activities leading to the DNA in question being picked up, and on the activities surrounding its deposition at the location where it is sampled. Between these activities however, there is often a time lapse and insufficient attention is given to activities that may have occurred during this period, or the impact they may have on profiles generated.

During any brief moment of time a person is often touching something. This could include touching themselves, another individual or an object/surface. The latter may be an item they are wearing, using or have their hand resting on, and could be personal, shared with others or solely belonging to/used by others.

Depending on its use and ownership, the sources and quantities of DNA on each item will vary.

Most contacts between them surfaces will result in an exchange of material between them. This could result in a loss and/or gain of DNA from or to the object from which a DNA sample is collected for further investigation. DNA transfer is influenced by factors such as the nature of the biological material, the composition of the surfaces coming into contact, the freshness of the sample/s at time of contact, the manner of contact and other unidentified factors [1–8]. Detecting transferred DNA is not only dependent on the quantity transferred, but the quantity and quality relative to other sources of DNA that may be present on the contacting surfaces that are co-collected during sampling.

As more items are contacted by the originally deposited biological sample, the greater the likelihood of it no longer being detected on the surface it was originally deposited on, or on the surface it was considered ultimately to have been transferred. The level of loss will be dependent on the history of the substrates contacted in terms of who, how and when they were previously touched, as well as the manner of contacts.

So, even seemingly irrelevant everyday activities, that do not appear to have any direct association with the criminal act under investigation, could have a profound impact on the likelihood of

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**Table 1**  
Average touches<sup>a</sup> observed during the observation of each general activity over a specific duration.

General activity	Observers (n)	Duration/Obs (s)	Touches (n)			Part of hand (%)					Type of contact (%)			Owner of object touched (%)		Substrate of object touched (%)				
			Total (std)	Different areas	Same area with same part of hand	Whole hand (Frt)	Most of fingers	Fingertips	Palm	Back of hand	Friction	Pressure	Passive	Personal <sup>b</sup>	Non-personal <sup>c</sup>	Hard <sup>d</sup>	Fabric	Skin/hair	Wood/paper	Other <sup>e</sup>
Office multi-tasking	20	20.8	4.5 (2.4)	4.1	1.2	25	31	37	6	nr	41	43	16	69	31	56	6	17	19	1
Sitting at café (with devices)	15	24.1	6.4 (1.9)	4.5	3.5	12	25	45	12	7	34	27	39	49	51	47	0	26	16	11
Sitting at café (without devices)	10	25.7	9 (2.6)	6.4	6.3	20	31	39	6	4	21	40	39	27	73	16	17	24	40	2
On public transport (Set 1)	22	19.1	3.3 (1.6)	2	1.7	38	26	35	1	nr	49	31	20	74	26	74	14	11	0	0
On public transport (Set 2)	4	27.8	4.5 (1.3)	5	0	43	24	28	0	6	19	53	28	75	25	55	12	28	0	5
Eating meals	30	19.2	3.6 (1.6)	2.7	1.2	22	46	30	3	nr	29	50	21	67	33	62	1	11	19	8
Cooking	9	21.4	4.8 (1.6)	3.3	1.1	34	29	32	5	nr	16	64	20	34	66	51	16	2	2	28
At home	15	25	8.1 (2.7)	5	5.2	31	29	31	9	1	17	48	34	79	21	34	28	20	5	12
In the park	11	24.5	8.5 (2.2)	3.9	6.3	29	19	45	4	2	39	43	17	66	34	53	19	10	16	2
Other <sup>f</sup> (Set 1)	11	18.8	5.9 (3.9)	3.1	2.6	48	25	25	3	nr	47	39	14	65	35	31	38	8	5	18
Other <sup>f</sup> (Set 2)	13	27.2	8.9 (2.8)	5.5	5.4	25	32	34	7	1	5	68	27	53	47	42	4	26	18	10

nr = not recorded.

<sup>a</sup> If an object was touched by one hand it was recorded as one touch. However, if during that touch, one part of the hand touched one part of the object and a different part of the hand touched a different part of the object, then information regarding each of these sub-contacts was considered separately for the categories 'Part of hand', 'Type of contact', 'Owner of object' and 'Substrate of object touched'. Percentages have been rounded to the nearest whole percent.

<sup>b</sup> Personal includes self, personal objects and assumed personal objects.

<sup>c</sup> Non-personal includes other people and non-personal or assumed non-personal objects.

<sup>d</sup> Hard substrates, include metal, glass, ceramics and plastic.

<sup>e</sup> Other substrates, include food items, rubber surfaces and hard surfaces where the type of substrate was not clear.

<sup>f</sup> Activities such as exchanging/withdrawing money, shopping, and greeting people.

detecting a relevant quantity of DNA that is assumed to have been deposited during a specific action and later transferred during a crime related activity.

To help gain an understanding of the frequency and manner of the items and surfaces touched during everyday activities, we observed individuals performing a range of general activities and assessed a number of potentially relevant factors.

## 2. Materials and methods

160 videos relating to individuals performing a range of common activities were viewed and analysed for a range of factors (Table 1). The videos fit the following general criteria: readily accessible; duration of ~15–40 s; the apparent dominant hand visible at all times; able to readily recognise what was touched.

## 3. Results and discussion

Our findings show that several items are often touched during various general daily activities over relatively short periods of time (Table 1). On average, across all activities, a person performs ~5.7 touches with their dominant hand per 22.1 s, translating to ~15 touches per 60 s. The touches were of personal objects (including self) likely to contain the toucher's DNA and non-personal objects (including other people) likely to be DNA-free or contain DNA from other individuals. The objects touched were often of different surface compositions (substrate), handled with different parts of the hand and contacted in a range of manners. Some areas of an item were contacted multiple times by the same part of the hand. Sometimes the repeat contact was after having touched something else. Each contact will affect the loss and gain of DNA on that part of the hand making contact, as well as the amount remaining on the area of the object touched.

## 4. Conclusion

Appreciation and consideration of general activities that may have occurred during the time between key focus activities (i.e. those associated with the pickup of DNA in question at point A and deposit at collection site B) and their potential impact on what is deposited at the final collection site, are imperative when weighting alternative transfer scenario propositions of how DNA became present at a location.

## Conflict of interest

None.

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