Forensic Science International 278 (2017) 334–337

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

An investigation into secondary transfer—The transfer of textile fibres to seats

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ARTICLE INFO

Article history:
Received 22 December 2016
Received in revised form 31 May 2017
Accepted 27 July 2017
Available online 3 August 2017

Keywords:
Fibres
Secondary transfer
Persistence
Seats
Interpretation

ABSTRACT

Textile fibres can be transferred directly, person to person or person to scene (primary transfer), or indirectly via an intermediate (secondary transfer). In criminal cases involving a transfer of textile fibres, it is often the case that whilst the provenance of recovered 'crime significant' fibres is accepted by the defence, it is a particular activity leading to their transfer to a surface in question which is disputed. In such circumstances, transfer and persistence studies relating to fibres on a particular substrate in particular conditions assist in evaluating whether the presence of crime relevant fibres is more likely to have occurred by one particular activity compared to another.

This study investigates the effect of a time delay between the primary transfer of fibres to a garment on the numbers of subsequently secondarily transferred fibres to a seat. Two donor garments composed of polyester and cotton fibres respectively were employed in this study and secondarily transferred to seats after time intervals of 0, 0.5, 2, 6 and 24 h. The number of secondarily transferred fibres were recorded according to fibre type and time interval and compared against levels recorded at the primary transfer stage. The results showed that only a relatively small percentage of the original primary transfer is likely to be secondarily transferred and that the numbers found were inversely proportional to the time interval between the primary and secondary transfer. In addition, it was found that the secondary transfer of cotton fibres was an order of magnitude higher than for polyester.

1. Introduction

The forensic examination of textile fibres is of proven utility in the investigation of crime addressing both source and activity level propositions [1,2] of interest to the court. However, it is often the case that whilst the provenance of recovered 'crime significant' fibres is accepted by the defence, it is the alleged activity leading to their transfer to a particular substrate which is disputed. In such circumstances, transfer and persistence studies relating to fibres on a particular substrate in particular conditions assist in evaluating whether the presence of crime relevant fibres is more likely to have occurred by one particular scenario compared with another.

The primary transfer and persistence of fibres has been the subject of numerous studies investigating various substrates [3–17], however, whilst the importance of secondary transfer is widely accepted [18,19] and often cited as a defence proposition, by contrast there is a paucity of published data concerning the transfer and persistence of secondarily transferred fibres [17–19].

Previous studies involving secondary transfers and seats [17,18] investigated the levels of fibres secondarily transferred from seats to clothing. These studies identified car seats as being particularly problematic, since they are generally present in semi closed environments, and are infrequently cleaned (compared to clothing) meaning they are likely to retain a pool of fibres from a primary contact which become available for secondary transfer. A similar study [19] investigated pillowcases as recipient items for fibres secondarily transferred from balaclavas via head hair and demonstrated that a significant pool of secondarily transferred fibres was still present on this substrate after 14 days.

This present study, investigates the effect of time interval after initial primary contact with a garment, on the numbers of fibres subsequently secondarily transferred to a seat. The authors believe that the results of this study complement the results from previous studies investigating the transfer and persistence of fibres [3–20] in evaluating examination outcomes with respect to whether one particular activity compared to another, is responsible for the presence of crime relevant fibres.

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http://dx.doi.org/10.1016/j.forsciint.2017.07.035
0379-0738/

2. Materials/methods

2.1. Donor garment

The primary source of the two target fibres ('donor garments') were long sleeved tops consisting of 100% polyester and 100% cotton respectively, both of which were evaluated as having 'good' shedability. Prior to the commencement of the study, the polyester garment was hand dyed orange, the cotton garment purple. This was performed in order to produce distinctive target fibres which facilitated the searching and recovery from surface debris tapings.

Appropriate representative control (reference) samples were taken from each garment for subsequent low and high power microscopic comparisons (Leica M60 low power stereomicroscope and Leica DMR comparison microscope respectively).

2.2. Primary recipient garments (primary transfer)

White long sleeved acrylic tops were used as the recipient surfaces for the primary transfer. In order to facilitate searching for the transferred target fibres, the recipient garments were 'blanked' prior to the transfer experiments using J-LAR™ tape to remove the majority of 'foreign' fibres. These tapes were checked to ensure that no target fibres were present before proceeding with the experimental run.

2.3. Secondary recipient seats (secondary transfer surface)

The seats used were identical in design and construction, located in different rooms throughout the building where the experiments were conducted, with one seat per experiment conducted used. The upper aspect of the seat base (squab) was comprised of dark blue nylon; the front aspect of the seat back was also comprised of nylon but was light blue in colour. All of these surfaces were tightly woven, did not readily shed their constituent fibres, but retained transferred fibres well. As with the primary recipient garments the seats were 'blanked' and surface debris recovered using 5 cm wide J-LAR™ tape (high tack) to remove the majority of 'foreign' fibres prior to the transfer experiments.

3. Experimental method procedure

3.1. Baseline primary transfer estimations

The donor garment was worn by subject 1; subject 2 wore the primary recipient garment. Both subjects then hugged each other over arm for 1 min and then underarm for a further minute remaining static during this activity. The garments were then placed in packages and returned to their own designated examination/storage areas, prior to fibre recovery via taping.

After a minimum of 24 h, having showered and changed clothes, subject 2 then recovered surface debris using 5 cm 'J-LAR™' high tack tape, which was then secured to a transparent acetate sheet for subsequent searching using low power microscopy.

3.2. Secondary transfer estimations

Primary transfer to the recipient garment was achieved using the method outlined for the baseline primary transfer estimations. Subject 2 continued to wear the primary recipient garment for the required post transfer time interval (i.e. 0, 0.5, 2, 6 or 24 h depending on the experiment number). Since in a real case scenario it is unlikely that the exact nature and degree of post activity would be known, other than being instructed to go about their 'normal' business, no record or control of post contact activity by the subject was taken.

When the selected post transfer time interval had ended, subject 2 went to the designated room containing the seat where they sat for a total of 5 min. Driving motions were not simulated. Subject 2 removed the primary recipient garment and then recovered surface debris from the surfaces of the seat. The primary recipient garment and surface debris tapings were then returned to their designated areas.

Surface debris was recovered using J-LAR™ tape lifts taken from both the seat back and base, using separate tapes for each area. The tape lifts were then searched using low power microscopy, for the presence of any fibres resembling those comprising the primary donor garment. Any such fibres were removed and mounted in *phytohistol* for subsequent high power comparison microscopy to confirm a match with the primary donor garment.

A schematic of the experimental procedure is shown in Fig. 1.

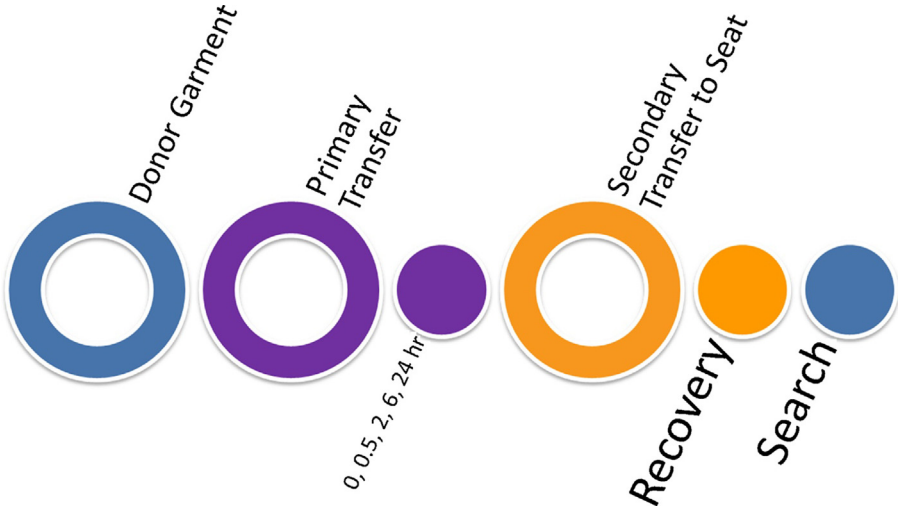

Fig. 1. Schematic of experimental procedure.