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Are Fingerprint Patterns Inherited Through Genetics? Dr. Gopala Krishnan¹, Kavya.R², Shilpa.B²

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ABSTRACT

Fingerprints are an interesting feature of human biology that have been used for a number of practical purposes like individual identification. Have you ever looked at two different people and thought they looked so similar that they must be sisters/brothers/cousins? What about a mother and her daughter? We have often tell that two people are related because they appear to have several similar physical traits. This is because offspring receive half of their DNA blueprints, from each parent. What about fingerprints; are they an inherited trait? Fingerprints, impression are made by the papillary ridges on the edges of the fingers and thumbs. DNA can be obtained from every single fingerprint. However, there are several problems linked to a fingerprint samples as DNA source.

I. INTRODUCTION

The basic fingerprint patterns are inherited through genetics. During 10th week of pregnancy - 24 of gestation (when a fetus is developing inside of its mother's womb, also called in utero), ridges form on the epidermis, which is the external layer of skin, on the fingertips of the foetus. The outline that these ridges make is known as a fingerprint. Fingerprints are constant and they don't change through out their lifetime, so an individual will have the same fingerprint from infant to old age. The fingerprint pattern changes size, but not shape, as the person grows. (To get a better idea of how that works, you can make fingerprint impressions of the whole family and you can see the differences.) Since each person has different and unique fingerprints that do not change over life time, they can be used for identification of an individual person. For example, the cops use fingerprints to check whether a particular individual has been at a crime scene or not. Although the exact number, shape, and spacing of the ridges changes from individual to individual, fingerprints can be differentiated into three general categories based on their pattern type: loop, arch, and whorl, as shown in Figure 1, below. Since the DNA that a person inherits from their parents determines many characteristics and traits, such as wheather someone is right or left handed or which colour their eyes are, all biological sibilings inherit a mixture of their parents' DNA possess similar traits.

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II. MATERIALS AND EQUIPMENTS

- Paper or towel
- Dettol solution mixed with 50 percentage of wate
- Ink pad
- Double sided cellotape
- Scissors
- Ethanol solution
- Sibling pairs (at least 5)
- Unrelated pairs of people (at least 5)
- Optional: Magnifying glass
- ✤ Lab notebook

III. EXPERIMENT PROCEDURE

- To start this project, practice taking consistent and clear fingerprints. First try the procedure on yourself, then ask a colleague or family member to let you learn by using his or her fingerprints.
- Use ethanol solution to clean the person's left thumb finger.
- Thoroughly dry the finger with a paper towel.
- Press and slide each side of the the left thumb fingertip one time over the ink pad. To make an ink pad variation, place the person left thumb finger on the ink pad several times until an area of about 3 by 3 centimeters (cm) is completely blue, as shown in Figure 2 (the paper on the left).
- Then roll the finger on the double sided cellotape to make a clear fingerprint impression.
- Use another towelette to clean the person's blue ink finger.
- Cut off the piece of doublesided cellotape containing the fingerprint and stick it onto a piece of white paper, as shown in Figure 2.
- Practice the procedure until the fingerprints come out clear each time.
- When your prints start to fade, rub your thumb a couple of times over your ink pad and try again.



FIGURE:1



FIGURE:2

Figure 2: To create a fingerprint, apply pressure and slide each side of the person's fingertip over the pad once, then roll the fingertip onto the sticky side of the tape and stick the tape to a piece of white sheet.

- Obtain the fingerprints of pairs of siblings and of pairs of unrelated people. Make sure they sign a constant form before you take the fingerprint.
- Use the cleaning and printing system you developed in step 1 to take one fingerprint of each person's right thumb finger.
- Label each fingerprint with a unique code, which will tell you which pair the fingerprint belongs to or whether if the finger print is sibling pair or an unrelated pair. An example of an suitable code would be to assign each pair a number and each individual a letter. Siblings would be labelled as subjects A and B, while unrelated individuals would be labelled as subjects 1 and 2. Thus, fingerprints from a sibling pair might carry the codes \$A and \$B while fingerprints from a unrelated pair might be labelled #1 and #2.
- Collect fingerprints from at least 5 sibling pairs and 5 unrelated pairs. As an example, you could pair sibling \$A with sibling \$B since these individuals are not related to each other.
- For example, the cops use fingerprints to determine whether a particular individual has been at a crime scene. Although the exact number, shape, and spacing of the ridges changes from person to person, fingerprints can be sorted into three general categories based on their pattern type: arch, whorl and loop.
- Look at drawings or pictures given below of the three basic fingerprint pattern type : arch /whorl/loop.
 1.In a arch pattern the ridges enter from one side,make a small rise in the center and exit generally on the opposite side.
 2.In a whorl pattern the ridges are usually circular.
 3.In a loop pattern the ridges enter from either side,curve up and then exit usually from the same side they entered.

Examine each fingerprint , You can use a magnifying glass if you have one. In your lab notebook, make a data table like Table 1, generating a separate row for each person, and fill it out.



Related Pairs (unique ID)	Fingerprint Category (arch / whorl / loop)	Related Category match in percentage% (\$A & \$B)
\$A	Simple arch	~ 75%
\$B	Tented arch	~ 75%

Unrelated Pairs (unique ID)	Fingerprint Category (arch / whorl / loop)	Related Category match in percentage% (#1 & #2)
#1	arch	~25%
#2	loop	~30%

RELATED PAIRS OF FRINGERPRINTS:

NAME	FAMILY	AGE	PLACE
RAMESH	FATHER	45	HOSUR
NAGAMMA	MOTHER	41	HOSUR

DHANUSH	BROTHER	18	HOSUR
KAVYA	SISTER	20	HOSUR
AISHU	SISTER	22	BENGALUR

UNRELATED PAIRS OF FINGERPRINTS:

NAME	AGE	PLACE
SHILPA	20	HOSUR
RACHANA	23	DHARMAPURI
SARASWATI	42	BENGALUR
HARIPRASADH	16	HOSUR
RAVI	35	HOSUR

IV. OBSERVATION

There is an inheritance component to fingerprint patterns but the genetics of how they are inherited are complicated .(Multiple genes are involved) Fingerprints are also affected by a persons environment wild developing in the womb. Because of this, you may have seen some examples of fingerprint patterns likely being inherited(such as a son and /or daughter having the same pattern type as their father).But this may not have always been the case for the ones you know to be closely related. To see more clearly how fingerprint patterns are inherited you would need to use a much larger sample size, such as described in the first "extra" step. Because each person's fingerprints are exclusive, and not even identical twins -who share the same DNA, have identical fingerprints, this also shows that fingerprints are not completely guarded by genetics.

V. CONCLUSION

After performing the experiment it was concluded that fingerprint patterns are genetically inherited. Two different families were tested, which included parent and offspring. Once the data was collected, it was concluded that fingerprint patterns are inherited due to the fact that every fingerprint of either parent is compatiable to the offspring. Unrelated persons from different families have various types of fingerprints which are unique from each other.

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