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# Comparison of sensorial comfort properties of different cotton fabrics using the Kawabata Evaluation System

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EMİNE UTKUN

## ABSTRACT – REZUMAT

### Comparison of sensorial comfort properties of different cotton fabrics using the Kawabata Evaluation System

*Cotton fabrics are among the most preferred fabrics for both underwear and outerwear. The sensory comfort properties of the fabrics are important for consumers' choice of clothing. The majority of consumers visually like the clothes that they buy and try to feel these features sensually by touching them, and then, they may want to try the garment or they can make direct purchasing decisions according to these tactile feelings.*

*In this study, the sensorial properties of a double-layered cotton fabric developed for use as a garment were compared and evaluated with cotton plain woven and interlock fabrics currently used in the market for this purpose. Sensorial comfort properties of the fabrics were researched with KES-F Kawabata equipment.*

**Keywords:** *sensorial comfort properties, Kawabata Evaluation System, cotton fabrics, clothing comfort, double-layered fabric*

### Compararea proprietăților de confort senzorial ale diferitelor materiale textile din bumbac folosind sistemul de evaluare Kawabata

*Materialele textile din bumbac sunt printre cele mai preferate, atât pentru lenjerie de corp, cât și pentru îmbrăcămintea exterioară. Proprietățile de confort senzorial ale materialelor textile sunt importante pentru alegerea îmbrăcămintei de către consumatori. Majorității consumatorilor îi plac vizual produsele de îmbrăcămintă pe care le cumpără și încearcă să simtă aceste trăsături atingându-le, iar apoi, ar putea dori să probeze sau să ia decizii directe de cumpărare în funcție de aceste simțuri tactile.*

*În acest studiu, proprietățile senzoriale ale unei țesături duble de bumbac realizată pentru a fi utilizată pentru articole de îmbrăcămintă au fost comparate și evaluate cu țesătură cu legatura pânză și cu tricot cu structura interlock din bumbac, utilizate în prezent pe piață în acest scop. Proprietățile de confort senzorial ale materialelor textile au fost investigate cu echipamente KES-F Kawabata.*

**Cuvinte-cheie:** *proprietăți de confort senzorial, sistem de evaluare Kawabata, materiale textile din bumbac, confortul articolelor de îmbrăcămintă, țesătură dublă*

## INTRODUCTION

Clothing is an inseparable part of human life. Clothing comfort can be defined as when a person feels physiologically, psychologically and physically balanced and pleased in that clothes under the current ambient conditions. Clothing comfort is an important factor in the stage where people make their clothing selection. Researches on this subject are valuable for increasing people's living standards [1–3].

Clothing comfort is divided into sub-components as thermal, sensorial (tactile), body movement and psychological (aesthetical) comfort [4].

The sensorial comfort of a fabric has multidimensional properties and is not possible by measuring a single physical property. The concept of "fabric handle" is generally used to evaluate the sensory or tactile comfort properties of fabrics [5].

Although the fabric handle is difficult to define precisely, it is accepted as a comprehensive assessment method that enables the perception of textile materials

with the sense of touch thanks to physical stimuli, one of the mechanical properties [6].

The best known, most remarkable and most modern method among the objective evaluation methods of fabric handle is the Kawabata Evaluation System (KES-FB) which has developed by Kawabata and her team in Japan [2, 6–10].

The Hand Evaluation Standardization Committee (HESC) has been established at the Kyoto University, Japan in 1972, for making a definition of "handle". Professor Sueo Kawabata developed the "Kawabata Evaluation System for Fabric" (KES-FB) in collaboration with this Committee [11].

Until now, researchers have used the Kawabata Evaluation System to investigate the tactile properties of fabrics used for different purposes [11–26].

In this research, the sensorial properties of a double-layered cotton fabric developed for use as a garment were compared and evaluated with cotton plain woven and interlock fabrics currently used in the market for this purpose.

## EXPERIMENTAL PART

### Materials

In this study, all three cotton samples were manufactured. Sample 1 was a plain fabric, sample 2 was a new-developed double-layered fabric, and sample 3 was an interlock fabric. Sample 1 and 2 were woven on a punched-card dobby loom with 8 frames, and sample 3 was knitted on circular knitting machine.

The details of the test samples, such as, yarn count, density, fibre type, fabric construction, texture report and knitting type are given in tables 1 and 2.

The determined properties of the fabrics, such as square mass and thickness are presented in table 3.

### Method

All the experimental studies were performed in the Textile Laboratories in the Department of Materials Science, in Fibre Materials at Tampere University of Technology. All the fabric samples were conditioned under the temperature of  $(20 \pm 2)^\circ\text{C}$  and relative

humidity of  $(65 \pm 5)\%$  for at least 24 hours before the experimental studies which were conducted in the same conditions.

Sensorial comfort properties were measured on KES-F Kawabata instruments according to "The Standardization and Analysis of Hand Evaluation" procedure.

Characteristic values of KES-F system are given in table 4 [27]. The sixteen characteristic values were calculated from the Kawabata instruments. All measurements, except compression, were made both in machine (warp) and in cross (weft) directions on face side. The size of one test piece was  $200\text{ mm} \times 200\text{ mm}$ . Four parallel tests were made for each sample in all Kawabata tests.

## RESULTS AND DISCUSSION

### KES-FB-1 Tensile

The test piece was stretched to the maximum load of 500 gf/cm with a speed of 0.2 mm/s. Determined

Table 1



DETAILS OF THE PLAIN WOVEN FABRICS								
Sample no.	Warp yarn			Weft yarn			Fabric construction	Texture report
	Yarn count (Ne)	Density (warp/cm)	Fibre type	Yarn count (Ne)	Density (weft/cm)	Fibre type		
1	80/2	24	100% Cotton	80/2	24	100% Cotton	Plain	
2	80/2	24	100% Cotton	80/2	30	100% Cotton	Two-layered	

Table 2

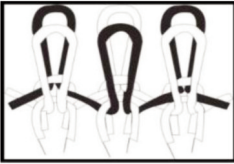
DETAILS OF THE KNITTED FABRICS					
Sample no.	Yarn count (Ne)	Fibre type	Stitch density (loops/cm <sup>2</sup> )	Knitting type	Texture report
3	40/1	100% Cotton	300	Interlock	

Table 3

SQUARE MASS AND THICKNESS OF THE FABRICS		
Sample no.	Square mass (g/m <sup>2</sup> )	Thickness (mm)
1	69.1	0.32
2	80	0.50
3	215.3	0.81

tensile values were according to standard settings (KES sensitivity  $5 \times 5$ , tensile preset 2.0, sample width of 20 cm and sample length 5 cm) for all the samples. LT tensile linearity, WT tensile work, RT tensile resilience and EMT elongation at maximum load were calculated in machine and cross directions. These results are presented in tables 5 and 6.

A low value of tensile linearity, LT means load extension curve is not linear. In other words, if value is

Table 4

CHARACTERISTIC VALUES OF KES-F SYSTEM			
Property	Symbol	Characteristic value	Unit
Tensile	LT	Linearity	–
	WT	Tensile energy	gf.cm/cm <sup>2</sup>
	RT	Resilience	%
Bending	B	Bending rigidity	gf.cm <sup>2</sup> /cm
	2HB	Hysteresis of bending moment	gf.cm/cm
Shearing	G	Shear stiffness	gf/cm <sup>0</sup>
	2HG	Hysteresis of shear force at 0,5° shear angle	gf/cm
	2HG5	Hysteresis of shear force at 5° shear angle	gf/cm
Compression	LC	Linearity	–
	WC	Compressional energy	gf.cm/cm <sup>2</sup>
	RC	Resilience	%
Surface	MIU	Coefficient of friction	–
	MMD	Mean deviation of MIU	–
	SMD	Geometrical roughness	micron
Weight & Thickness	W	Weight per unit area	mg/cm <sup>2</sup>
	T	Thickness at 0,5 gf/cm <sup>2</sup>	mm

Table 5

MEASUREMENT RESULTS OF TENSILE TESTS FOR LT TENSILE LINEARITY AND WT TENSILE WORK								
Sample no.	LT machine	CV (%)	LT cross	CV (%)	WT machine (gf.cm/cm <sup>2</sup> )	CV (%)	WT cross (gf.cm/cm <sup>2</sup> )	CV (%)
1	0.581	2.60	0.555	2.26	8.683	5.93	8.351	2.86
2	0.567	3.18	0.472	4.77	5.897	3.68	8.139	2.21
3	0.687	4.59	0.796	5.60	41.284	2.94	98.957	2.09

Table 6

MEASUREMENT RESULTS OF TENSILE TESTS FOR RT TENSILE RESILIENCE AND EMT ELONGATION AT MAXIMUM LOAD								
Sample no.	RT machine	CV (%)	RT cross	CV (%)	EMT machine (%)	CV (%)	EMT cross (%)	CV (%)
1	39.427	4.25	42.305	2.72	5.867	2.48	6.001	3.43
2	41.068	2.36	40.435	3.78	4.189	4.05	7.005	2.38
3	21.730	6.20	12.389	7.07	24.097	2.04	50.001	2.31

high, the curve is near to the straight line [28, 29]. LT is indicative of clothing comfort. Lower values of LT show higher fabric extensibility, and better comfort [15]. The values range from 0.567 to 0.687 in machine direction and from 0.472 to 0.796 in cross direction. The lowest values were measured from sample 2 in both directions. The highest values were measured from the knitted sample 3 in both directions.

Tensile work, WT, is the energy required for extending the fabric. High value means higher energy, and low value represents lower energy [28, 29]. The modified twill sample 2 had the lowest values in both directions and the knitted sample 3 had the highest values in both directions.

Tensile resilience, RT, means the ability of fabric recovery after applying the tensile stress. A low value means that recovering the original shape after removing the applied tensile stress is difficult for the fabric [28, 29]. The lowest values were measured from the knitted sample 3 in both directions. The highest value was measured from sample 2 in machine direction and sample 1 in cross direction.

Elongation at maximum load, EMT, is the percentage of elongation of the fabric from the beginning to the applying tensile stress. High elongation at maximum load value means that high extension at maximum load, low elongation at maximum load value means that low extension at maximum load [28, 29]. In other words, EMT states extensibility of the fabric. The

fabric is required to have sufficient extensibility in garment production [12, 15]. The highest values were measured from sample 3 in both directions. The lowest value in machine direction was measured from sample 2 and in cross direction from sample 1.

### KES-FB-2 Bending rigidity

The settings were made according to the thickness of the samples. All the fabrics were thin, and KES sensitivity 2×1 and sample width of 20 cm were used for all the samples. The results of bending rigidity B and hysteresis 2HB are given in table 7 in machine and cross directions. Machine direction refers warp direction and cross direction refers weft direction. Test piece was bended first to the warp and then to the weft direction. The average for forward and backward bending was calculated.

The hysteresis of bending moment 2HB represents the recovery ability of the fabric after bending. If the value of 2HB is low, return curve follows near the bending curve. In other words, the fabric recovers easily after bending. If the value of 2HB is high, return curve deviates significantly from the bending curve thus; the fabric recovers with difficulty after bending [28, 29]. A lower value of 2HB is better [24]. In machine and cross directions, the lowest hysteresis of bending moment value was measured from sample 1.

Sample 1 and 2 were woven fabrics and they bend and recover easily in weft direction, it might be due to the weaving process. Warp yarns were more stable than weft yarns on the shuttle loom during the weaving. Warp yarns were fixed on the shuttle loom, however weft yarns were moving. Sample 3 was a knitted

Table 7

MEASUREMENT RESULTS OF BENDING RIGIDITY TESTS								
Sample no.	B machine (gf.cm <sup>2</sup> /cm)	CV (%)	B cross (gf.cm <sup>2</sup> /cm)	CV (%)	2HB machine (gf.cm/cm)	CV (%)	2HB cross (gf.cm/cm)	CV (%)
1	0.024	8.15	0.022	8.30	0.018	10.89	0.015	16.42
2	0.053	6.75	0.033	5.21	0.037	10.13	0.021	18.89
3	0.072	4.57	0.019	6.08	0.057	7.30	0.025	10.63

Low bending rigidity (B) value means that fabric bends easily. High bending rigidity (B) value means that fabric resists bending [28, 29]. Bending rigidity (B) is a measure, which influence the sewability of the fabrics. The lower the bending rigidity, the lower is a fabric's ability to resist when it is bent by exterior forces that may occur during manufacturing processes [12, 15]. The values were in range of 0.024–0.072 in machine direction and 0.019–0.033 in cross direction. In machine direction, the lowest rigidity value was measured from sample 1. In cross direction, the lowest rigidity values were measured from sample 3. Thickness is also important for this property, so correlation analysis was performed between bending rigidity and thickness of the samples (table 8). There was an excellent relationship between B machine and thickness value. It means that when the thickness of the sample increases, so does the bending value in the machine direction. In addition, there was a negative fair degree of relationship between B cross and thickness value.

fabric and it bends and recovers easily in weft direction, too. It may be due to the knitting process. In knitting process of sample 3, loops were produces in the weft direction one by one, respectively.

### KES-FB-1 Shear

Shear values were measured on the same Kawabata instrument (KES-FB1) as the tensile values. Shear values were obtained according to standard settings (KES sensitivity 2×5, sample width 20 cm, sample length 5 cm, shearing angles ±8°) for all the samples. The sample was placed between jaws, and back jaws moved maximum 8° in side direction to the left, and then returned to the beginning position. The applied shear deformation was 10 gf/cm [28].

The shearing stiffness G and the hysteresis values at shearing angles of 0.5° (2HG) and of 5° (2HG5) are given in both directions in table 9.

If shear stiffness value is low, the sample is easy to shear and it resists shearing while the value is high [28, 29]. Shear deformation is very important during wearing since the fabric needs to be stretched or sheared, so it affects body movement comfort. This property is also substantial during the garment manufacture. If the shear stiffness is not enough, fabric will defect easily. If it is too high, such problems, like forming, moulding, or shaping can be seen [12]. The values ranged from 0.156 gf/cm<sup>0</sup> to 0.821 gf/cm<sup>0</sup> in machine direction and from 0.150 gf/cm<sup>0</sup> to 0.812 gf/cm<sup>0</sup> in cross direction. The highest values were measured from sample 3 in both directions. The lowest values were measured from sample 2 in both directions. The modified twill sample 2 had higher

Table 8

CORRELATION MATRIX OF BENDING RIGIDITY		B machine (gf.cm <sup>2</sup> /cm)	B cross (gf.cm <sup>2</sup> /cm)
Thickness (mm)	Pearson Correlation – r	0.963	–0.349
	Sig. (2-tailed)	0.173	0.773
	Number of Samples	3	3

Note: Correlation is significant at the 0.01 level (2-tailed).

Table 9

MEASUREMENT RESULTS OF SHEAR TESTS												
Sample no.	G machine (gf/cm <sup>2</sup> )	CV (%)	G cross (gf/cm <sup>2</sup> )	CV (%)	2HG machine (gf/cm)	CV (%)	2HG cross (gf/cm)	CV (%)	2HG5 machine (gf/cm)	CV (%)	2HG5 cross (gf/cm)	CV (%)
1	0.402	10.784	0.237	4.55	0.053	7.04	0.509	9.33	0.526	11.19	0.853	2.78
2	0.156	5.788	0.150	4.12	0.144	3.02	0.248	2.64	0.285	4.90	0.451	3.42
3	0.821	2.239	0.812	3.25	3.512	6.86	4.587	6.91	4.409	9.23	5.589	5.35

shear stiffness in machine direction than in cross direction.

If the value of hysteresis at 0.5°, 2HG is low, the return curve goes nearby the shear curve; therefore the fabric recovers easily after applying the shearing stress. If the value of hysteresis at 0.5°, 2HG is high, the return curve deviates much from the shear curve. In other words the recovery ability of the fabric is poor [28, 29]. The highest values were for sample 3 in both directions. The lowest value was for sample 1 in machine direction, for sample 2 in cross direction.

For hysteresis at 5°, 2HG5, a low value refers that the return curve does not deviate much more from the shear curve and the fabric recovers easily from shearing [28, 29]. Sample 3 had the highest value in both directions. Sample 2 had the lowest values in both directions.

The knitted sample 3 had higher shearing stiffness, the hysteresis values at shearing angles of 0,5° and of 5° than the woven fabrics 1, 2. In addition, for all the samples the hysteresis values at shearing angles of 0,5° in cross direction were higher than in machine direction. The biggest difference was in sample 1.

### KES-FB-3 Compression

Compression values were determined according to standard settings (KES sensitivity 2×5, compression force 50 gf/cm<sup>2</sup>, compression speed 1 mm/50 s, sample width 20 cm) for all the samples. The results are given in table 10.

Fabric compression is highly related to fabric handle, softness and surface smoothness [12].

If compressibility value, EMC is low, the fabric compressibility is low or if compressibility value, EMC is high, the fabric compressibility is high. If a material is harder and denser, it can be compressed less [28, 29]. Sample 1 was the most and sample 3 was the least compressible. According to our results, it is obvious that as the weight and thickness of the fabric

increases; the compressibility decreases (tables 3 and 10).

A high value of linearity, LC, means that the compression curve does not deviate remarkably from a straight line, therefore it is linear, and low value means that it deviates significantly [28, 29]. Sample 1 had the lowest value and sample 2 had the highest value.

Compression energy, WC, with a high value means compression needs high-energy supply, and a low value means compression needs low-energy supply [28, 29]. The lowest value was noted for sample 1 and the highest value for sample 2.

Compressional resilience value, RC, shows the ability to recover of the fabric after the compression deformation. The low value refers the retention ability of deformation after compression is good. In other words, the high value refers the ability to recover is poor [28, 29]. Sample 3 had the lowest value and sample 2 had the highest value.

### KES-FB-4 Surface friction

Surface friction values were determined according to standard settings (KES sensitivity 2×5 and sample size of 200 mm × 200 mm) for all the samples. In addition, when preparing the experimental setup to place the fabric on the instrument, for sample 3, it was used 80 gf weight and, for samples 1, 2 it was used 200 gf weight. Weights were adjusted according to the thickness of the samples. A five-millimetre wide metal “finger” sensor, with a similar surface as human fingertip, was used for the measure.

Samples were moving by a constant speed of 0.1 cm/s on a horizontal smooth steel plate between 2 cm interval in surface friction and roughness tests [26].

It is well known that the handle of the fabrics is closely related to the surface properties. There were wrinkles on the surface of the woven test samples. Because they had been washed in water but they

Table 10

MEASUREMENT RESULTS OF COMPRESSION TESTS												
Sample no.	LC	CV (%)	WC (gf.cm/cm <sup>2</sup> )	CV (%)	RC (%)	CV (%)	T0 (mm)	CV (%)	Tm (mm)	CV (%)	EMC (%)	CV (%)
1	0.228	5.96	0.228	3.45	49.617	2.29	0.501	7.13	0.189	3.95	62.395	5.12
2	0.361	7.61	0.352	3.78	52.298	1.52	0.713	3.51	0.426	5.29	40.343	9.26
3	0.320	2.4	0.333	2.21	35.975	2.19	1.131	2.26	0.752	1.54	33.569	2.39

MEASUREMENT RESULTS OF FRICTION TESTS								
Sample no.	MIU machine	CV (%)	MIU cross	CV (%)	MMD machine	CV (%)	MMD cross	CV (%)
1	0.191	2.15	0.174	1.65	0.025	13.47	0.030	8.07
2	0.243	5.15	0.202	7.27	0.033	6.77	0.024	17.94
3	0.206	2.59	0.217	1.71	0.010	9.34	0.018	4.54

were not ironed not to damage them. On the other hand, knitted sample was finished under the relevant commercial production conditions, thus there weren't any wrinkles on their surface. This is the important point for surface properties, friction and roughness. The sensor was very sensitive and these wrinkles may have influence on the results.

The frictional coefficient MIU and mean deviation of MIU, MMD, are given in both directions in table 11.

A low value for MIU coefficient means low friction and a high value means high friction [28, 29]. The values ranged from 0.191 to 0.243 in machine direction and from 0,174 to 0,217 in cross direction. The lowest values were measured from sample 1 in both directions. The highest value in machine direction was measured from sample 2 and in cross direction from sample 3.

A low value for MMD, mean deviation of MIU, refers an even friction coefficient, and a high value refers an uneven friction coefficient [28, 29]. The lowest value was recorded from sample 3 in both directions. The highest value was recorded from sample 2 in machine direction, from sample 1 in cross direction.

#### KES-FB-4 Surface roughness

Surface friction values were determined according to standard settings (KES sensitivity 2×5 and sample size of 200 mm × 200 mm) for all the samples. Surface roughness values were measured on the same Kawabata instrument (KES-FB4) as friction. However, measuring sensor was different, a U-shaped metal wire (5 mm wide).

Geometrical roughness SMD values are presented in both directions in table 12.

Table 12

MEASUREMENT RESULTS OF SURFACE ROUGHNESS TESTS				
Sample no.	SMD $\mu$ machine	CV (%)	SMD $\mu$ cross	CV (%)
1	8.463	2.46	7.166	2.46
2	11.751	2.85	14.197	5.61
3	1.102	1.32	3.945	2.00

If geometrical roughness value is low, the surface of the fabric is smooth or even. In other words, high value of geometrical roughness means an uneven surface [28, 29]. The values ranged from 1.102  $\mu$  to 11.751  $\mu$  in machine direction and from 3.945 to

14.197  $\mu$  in cross direction. The roughest was sample 2 in both directions. The smoothest was sample 3 in both directions.

#### CONCLUSIONS

Kawabata Evaluation System is a user-friendly instrument to determine total hand value of the fabrics. In other words, it can easily measure tactile properties of the fabrics. These properties are important for the prediction of garment appearance and determination of the problems that may arise in manufacture.

In this study, a double-layered cotton fabric was developed, the sensory properties were investigated by Kawabata Evaluation System, and these properties were compared with one woven and one knitted fabric currently used in the market for clothing.

All of the fabrics are thin and can be used as summer clothes or in hot weather. Underwear, shirts, blouses, baby clothes can be produced from these fabrics. The purpose of developing a double-layer fabric is to obtain a more breathable and softer structure than other fabrics thanks to the presence of air between the layers.

Samples, compared in terms of bending rigidity, shearing stiffness, compressional resilience, frictional coefficient, surface roughness according to their structure, respectively.

Sample 2 was bended as easily as the other fabrics. Stretching of sample 2 fabrics required lower amount of energy than the sample 3. The woven fabrics were easier to shear than the knitted fabric. The modified twill woven fabric (Sample 2) and knitted fabric (Sample 3) were close each other, and their retention ability of deformation after compression is better than the plain-woven fabric (Sample 1). The frictional coefficient of the woven fabrics (Sample 1, 2) and the knitted fabric (Sample 3) were close each other. The surface roughness of the knitted fabric (Sample 3) was even than the woven fabrics (Sample 1, 2), but it could be due to the finishing process.

In the light of these findings, it can be concluded that these values of the double layer fabric (Sample 2) are close to or better than the fabrics used in the market and can be used for clothing purposes. It is good enough to serve its function. Additionally, it is thought to have different advantages in terms of thermal comfort as it is double-layered and keeps air between the layers. These properties can be investigated in another study.



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# Investigation of frictional impact on polyester yarn during knitting

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## ABSTRACT – REZUMAT

### Investigation of frictional impact on polyester yarn during knitting

*The usage of polyester (PET) in fabrication is increasing day by day due to its properties, ease of physical and chemical modification. The aim of this work is to understand the effect of temperature on Polyester (PET) during knitting. For checking the rise of temperature Infrared (IR) camera is used. Microscopic images are used for studying the effect of temperature on fibre/yarn structure. Morphological analysis is also done by X-ray diffraction (XRD) which shows disturbance of polymeric chains, causing change in crystal size due to elevated temperature. The beads formation and filament breakage are clearly seen in images. Due to this knitting fault, shade variation after dyeing occurred. It is concluded that structural morphology of polyester yarn changes due to friction of yarn with knitting machine parts. Fabric appearance and fabric quality also disturbed which leads to rejections and high losses.*

**Keywords:** polyester (PET), weft knitting, friction, structure and properties

### Analiza impactului de frecare asupra firului de poliester în timpul tricotării

*Utilizarea poliesterului (PET) în fabricație crește pe zi ce trece datorită proprietăților sale și modificărilor fizice și chimice. Scopul acestei lucrări este de a înțelege influența temperaturii asupra poliesterului (PET) în timpul tricotării. Pentru verificarea creșterii temperaturii se folosește o cameră cu infraroșu (IR). Imaginile microscopice sunt folosite pentru studiul influenței temperaturii asupra structurii fibrei/firului. Analiza morfologică se efectuează și prin difracție de raze X (XRD), care arată perturbarea lanțurilor polimerice, determinând modificarea dimensiunii zonei cristaline din cauza temperaturii ridicate. Formarea efectului de perlare și ruperea filamentului se observă clar în imagini. Din cauza acestui defect de tricotare, a apărut o variație de nuanță după vopsire. Se ajunge la concluzia că morfologia structurală a firului de poliester se modifică datorită frecării firului cu piesele mașinii de tricotate. De asemenea, aspectul și calitatea tricotelui sunt perturbate, ceea ce duce la respingeri și pierderi mari.*

**Cuvinte-cheie:** poliester (PET), tricot din bătătură, frecare, structură și proprietăți

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## INTRODUCTION

Polymers can be natural or synthetic depending on their origin i.e., natural or synthetic [1, 2]. Depending on the form and use of polymers can be classified as plastics, elastomers, fibre or liquid resin [3–4]. Polymers have different mechanical & thermal properties according to their nature [5–6]. If these polymers are drawn into long lengths, whose length is 100 times more than its diameter, polymers are called fibre [7]. Some typical examples of these polymers are Polyesters, Nylon, polypropylene etc. These fibres are extensively used in textile sector and other industries and their potential use is increasing rapidly. Polyester (PET) fibres take a leading position among all chemical fibres. Poly(ethylene terephthalate) (PET) is the predominant polyester used for fibre production, not only because of its good end-use properties and economy of production but in particular because of the ease of physical and chemical modification, suppressing negative and enhancing positive properties of PET fibre has become very successful in the conventional as well as in fashion

industry due to its chemical resistance, wrinkle resistance and its quick-drying properties. The unique properties of these fibres are due to the presence of aliphatic and aromatic parts in macromolecular chains and the regular molecular structure [8]. PET has much demand over all other synthetic fibres. PET (filament and staple) makes up to 95 % + of future global synthetic fibre production growth [9]. Due to durability and less in cost it is used in many fabrication techniques. Knitting is the 2nd largest technique of fabric formation after weaving and has its charms due to comfort and flexibility. Knitted garments have vast application in casual, sports and formal wear.

Thermal damage is one of the most frequent causes of complaints about synthetic fibres. It leads many problems like yellowing, loss of strength, uneven fabric appearance (light reflection) and dyeing behaviour (spots, streaks etc.). Thermal damage can occur due to different process like singeing, pressing etc. Another form of thermal damage is the thermal deformation due to heat of friction, which can occur during friction,

impact, striking, cutting or punching out during textile production and garment manufacture. Heat due to friction/abrasion is the deterioration of textiles when in contact with another surface. Friction ultimately produces the heat, results in the lowering the performance characteristics e.g., strength, along with it also affects the surface look of the fabric [9–16]. Mahall has shown many typical examples of this [17]. Buchanan and Hardegree [18] described the influence of heat and tension (for example, during drawing, texturizing and occasionally dyeing) on faults in yarns made of polyester, nylon 6.6 and polypropylene. Nanal [19] investigated the damage due to excessive heat and mechanical effects.

The purpose of this research is to study the effect of heat due to frictional contact of knitting machine parts, on morphology of PET by showing good qualitative picture on the influence of structural changes in dyeing. Although other researchers also mentioned that due to excessive heat, structural differences occurred in the PET in woven fabric, but there is little or no study about the effect of heat on PET filament yarn during knitting.

## EXPERIMENTAL WORK

### Materials and method

The 100% PET intermingled yarn was used in two linear densities 100 denier and 150 denier for knitting. Intermingled yarn has filaments with binding points in its length and slightly twisted. Samples were produced on double jersey (Rib) and single jersey circular knitting machine of 30" diameter. Samples were produced of stich length 0.275 cm at a speed of 20 rpm. Total 4 samples were prepared. All the physical properties of samples were measured according to standards. Samples notations were made by software Degimizer in table 1.

### Testing

To observe that either temperature was increased or not IR camera was used. Real time measurement was done by IR camera on knitting machines Infrared (IR) camera, IR-916, Cantronic systems, Canada. The most important methods of investigation for thermal damage are microscopy, dyeing tests and thermal analysis [20].

### Microscopic analysis/study

Microscopy is usually the initial method of characterizing the textiles. Microscopic Mc 50(slides), 1280 (fabric) Micros, Austria 1000, magnification was used to analyse the fibre surface. Samples were taken after 5 minutes (min.) and 100 minute (min.) of machine working for both types of structures. Samples were prepared according to the size of glass slides and examined according to ASTM E2228.

### Morphology

For more detailed examination of particular components can be performed with techniques such as transmission and reflectance microscopy. X-Ray diffraction (XRD) is used to study the structure /morphology of materials. XRD analysis was applied using a PANalytical X'Pert Pro MPD, Netherland powered by a Philips PW3040/60 X-ray generator and fitted with an X'Celerator detector. Diffraction data is acquired by exposing powder samples to Cu-K $\alpha$  X-ray radiation, X-rays were generated from a Cu anode supplied with 40 kV and a current of 40 mA. The equatorial diffraction patterns ( $2\theta$ ) were recorded from 10 to 40. Intensity (I) calculated, I observed are drawn and their relation is expressed in the figures. The XRD analysis is taken according to XRD ASTM D3906. For this analysis the samples were taken for each type, one at initial stage i.e., 5 min and other sample at the elevated temperature of machine i.e., 100 min. and comparative analysis was done.

### Dyeing test

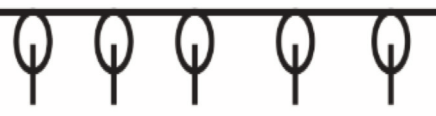
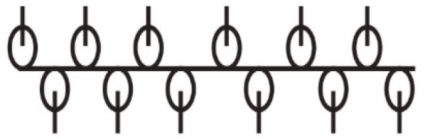
Dye test was also performed of all samples, to check the dye shade variation of samples. High temperature dyeing machine HD -12E, TSUJI, Japan was used. For this Disperse dye was used. The temperature of dyeing was 130°C. 1 g dispersing agent is used Acetic acid was added to control pH of the solution. The samples were dyed up to 45 minutes.

## RESULTS AND DISCUSSIONS

### Effect of temperature on polyester yarn

The relationship between heat generated verses time for single jersey machine and Rib machine are given in figures 1 and 2 respectively. Variation in temperature with time of the needle is given for single jersey machine (figure 1, a) and rib machine (figure 2, a).

Table 1

SAMPLE NOTATION					
Sample description	Machine settings			Notation	
	Track	Feeder 1	Feeder 2		
Single jersey	Cylinder	1	K	K	
		2	K	K	
1x1 rib	Dial	1	K	K	
		2	K	K	
	Cylinder	1	K	K	
		2	K	K	

While figure 1, *b* and figure 2, *b* show the change in temperature with time of cam box for single jersey and rib machine respectively. In weft knitting, due to frictional contact of yarn with different mechanical parts such as tensioners, feeders, guides, sinkers and needles, generates heat which leads to increase the temperature of the parts. The temperature of needle and cam was measured through IR camera after every 10 minutes intervals from 0 to 100 minutes working range, as needle and cam have direct frictional contact, which increase their temperature. The needle as well as cam box showed the same trend for rise in temperature verses time however the value of temperature was different. The elevation in temperature with time was higher for needle as compared to the cam box since the yarn was in direct frictional contact with needle which ultimately increases temperature of needle. However, cam box isn't in contact with yarn, so it heats up indirectly by the transference of heat from needle by the process of conduction and convection. That's why temperature elevation was found more in needle than cam box.

### Surface analysis

The effect of machine heat on the polyester yarn surface was analysed with Microscope which helps to determine the changes in yarn morphology. The microscopic images of yarn surface of single jersey fabric with 100 denier and 150 denier are shown in figure 3. The effect of machine heat is significant as shown in figure 3, *b* and *d*. Figure 3, *a* is the image of fabric taken after running of machine for 5 minutes which shows normal yarn surface and figure 3, *b* is the image of fabric taken after 100 minutes of machine start-up which shows filament breakages, bead formation and disturbance of filaments. Fabric made with 150 denier yarn has less effect of heat as compared to the 100-denier yarn as shown in figure 3, *c* and *d*. Same effect was analysed in the fabric surface made on Rib machine as shown in figure 4 fabricated with 100 denier and 150 denier filaments respectively.

The results depicted that the polyester yarn was normal without any observable change after 5 minutes of operation, whereas, when machine runs for 100 minutes, beads were formed on the surface of the yarn. The reason might be lies in frictional contact of the yarn with metallic machine parts at high speed of

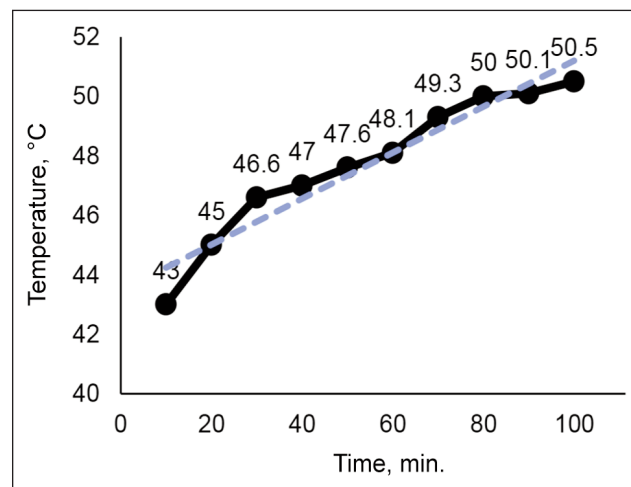
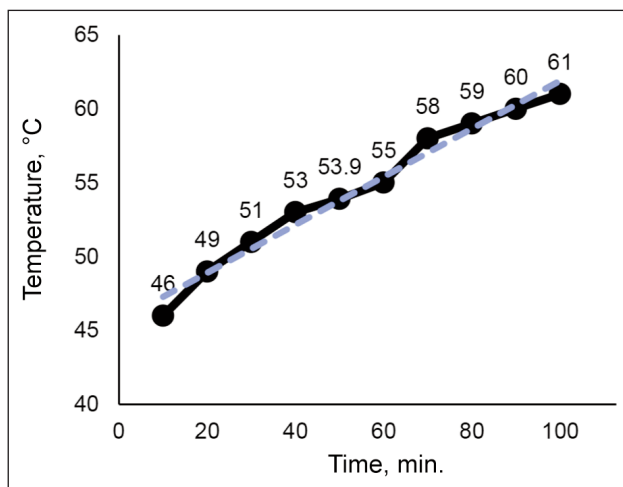


Fig. 1. Effect of running time on Needle & Cam box heat generation for Single jersey Machine: *a* – relation between running time and heat generated by needle; *b* – relation between running time and heat generated by cam box

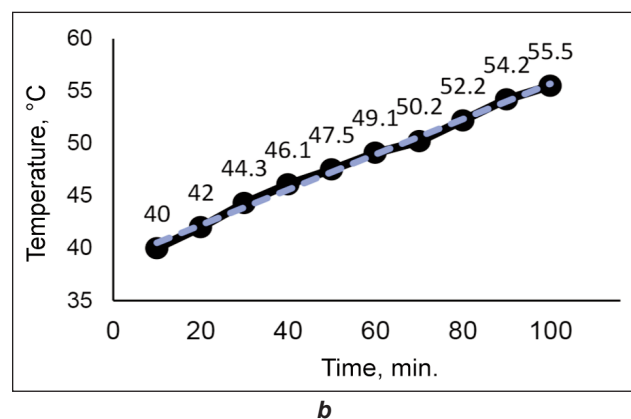
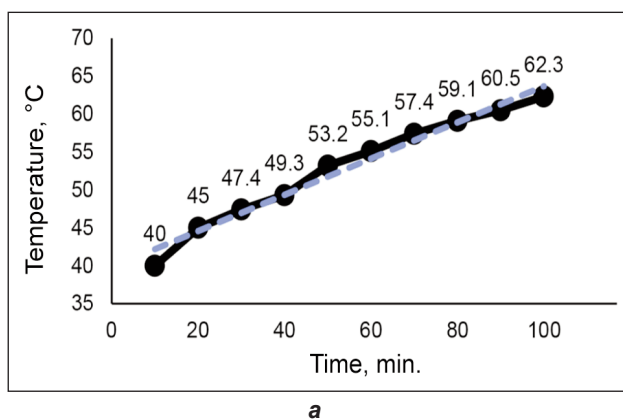


Fig. 2. Effect of running time on Needle & Cam box heat generation for Rib Machine: *a* – relation between running time and heat generated by needle; *b* – relation between running time and heat generated by cam box

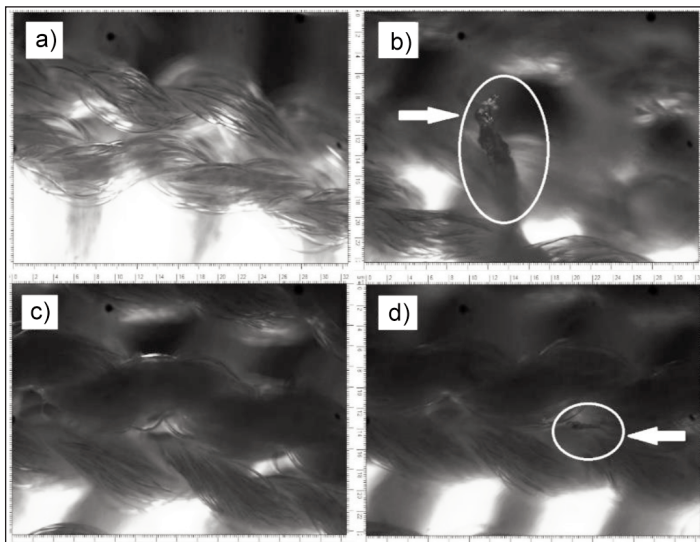


Fig. 3. Microscopic images of single jersey fabrics developed with different deniers at different time of operations, a – filament 100 denier at 5 minutes; b – filament 100 denier at 100 minutes; c – filament 150 denier at 5 minutes; d – filament 150 Denier at 100 minutes

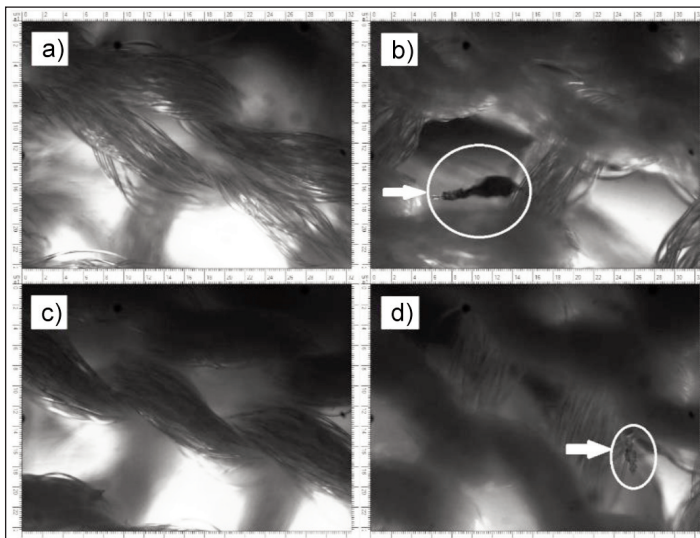


Fig. 4. Microscopic images of rib fabrics developed with different deniers at different time of operations: a – filament 100 denier at 5 minutes; b – filament 100 denier at 100 minutes; c – filament 150 denier at 5 minutes; d – filament 150 denier at 100 minutes

operation which causes friction and machine gets heated. When yarn passes through these heated parts, heat may transfer to the filaments which are on the surface of the yarn and beads are formed due to the melting at specific points.

### XRD analysis

XRD analysis was performed to determine the changes in thermal characteristics of the PET filament. The XRD analysis was done to check the effect of temperature on polymeric chains i.e., any modification in crystalline region of polymer. The diffractograms of single jersey and rib samples showed similar shapes. The typical diffractograms obtained for single jersey

fabrics fabricated with 100 denier at different operating hours are shown in figure 5.

The general shape of obtained diffractogram agrees with the literature reported diffractograms of partially crystalline polyester fibres. The peaks were obtained at 2theta position of 17.7°, 22.8° and 25.8°. The obtained peaks were characteristics reflections of (100), (010) and (110) crystal plane. The corresponding side spacing for obtained peaks were 4.98 Å, 3.89 Å and 3.45 Å respectively. The obtained results suggested that the basic crystal structure of all fabric samples is triclinic. It is hence concluded that influence of heat generated during knitting process to which polyester yarn was subjected did not influence the crystalline structure of polymer.

The peaks obtained at different operating hours were at same position with small change in peak height. The change in peak height changes the full width of peak at mid value of maximum peak height (FWMMPH) for samples at different operating hours. These results suggested small change in crystal size at different operating hours. The elevated temperature of machine parts due to frictional contact of PET yarn at high speed cause calendaring like effect. This result may also be caused due to damage of filaments by heated frictional contact with knitting machine parts. With the increase in temperature, the polymeric chains were heat treated with temperature gradient across the fibre diameter. In general, short exposure of heat treatment do not influence significantly on crystallinity but here abrasion effect on the fibre enhances and promotes skin treatment of fibre.

### Dyeing test

Dyeing test was performed to investigate the changes in dyeing behaviour after frictional contact. Figure 6 (100 denier) and figure 7 (150 denier) show the images of single jersey dyed fabric after 5 minutes and 100 minutes

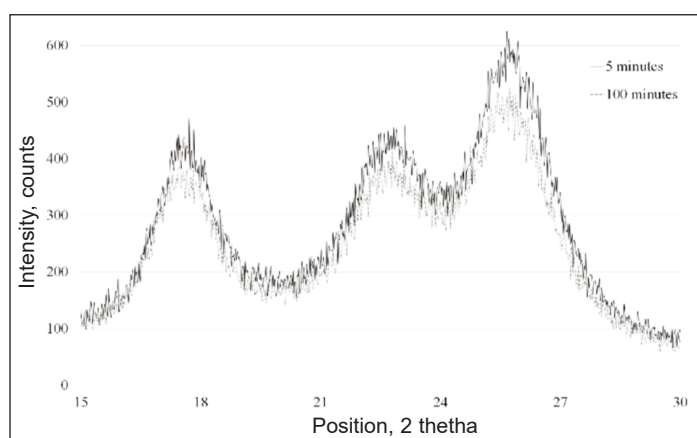


Fig. 5. X-Ray diffraction patterns of single jersey fabric samples at different operating hours

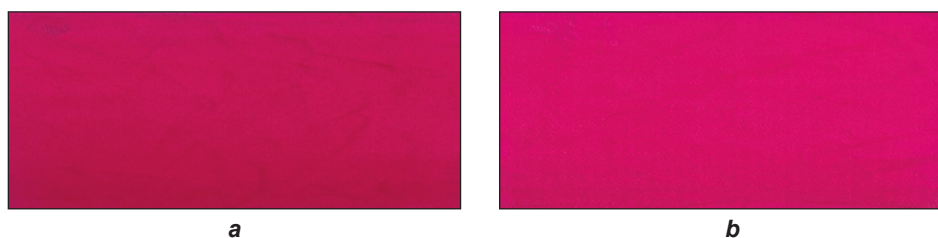


Fig. 6. Dyed single jersey knitted sample of 100 denier: *a* – after 5 minutes running of machine; *b* – after 100 minutes running machine

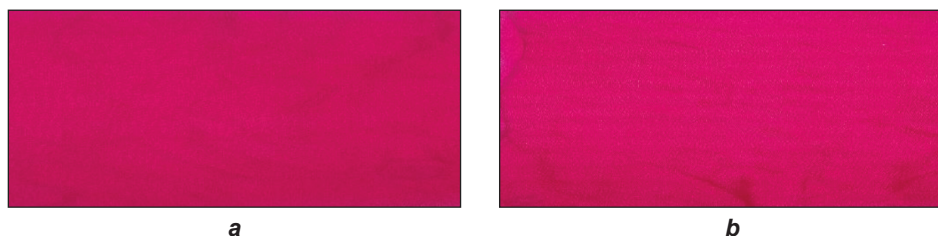


Fig. 7. Dyed single Jersey knitted sample of 150 denier: *a* – after 5 minutes of running machine; *b* – after 100 minutes of running machine

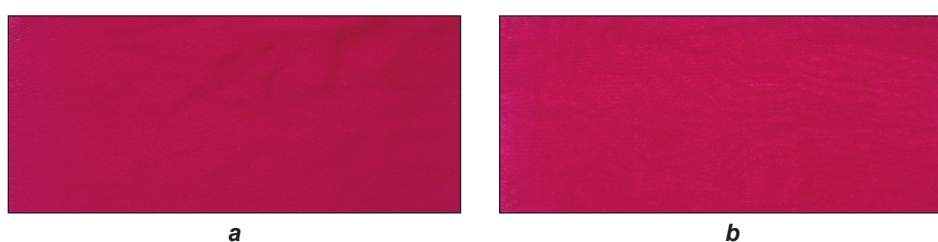


Fig. 8. Dyed Rib knitted sample of 100 denier: *a* – after 5 minutes running of machine; *b* – after 100 minutes running of machine

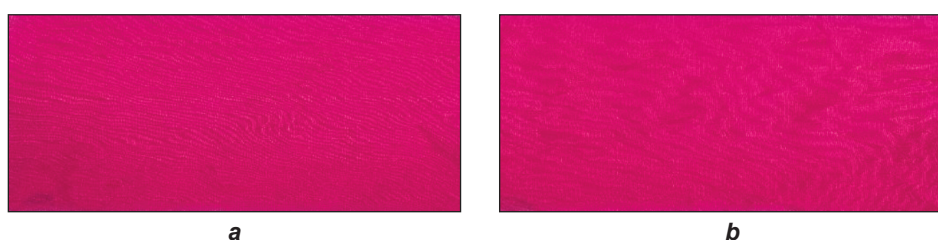


Fig. 9. Dyed Rib Knitted sample of 150 denier: *a* – after 5 minutes running of machine; *b* – after 100 minutes running of machine

respectively. A significant change in shade of the dyed fabric was observed between different operating hour samples. The fabric sample taken after 5 minutes (figure 8, *a*) of machine operation shows darker shade as compare to the fabric taken after 100 minutes figure 8, *b* of machine operation. The same change in shade was observed for rib dyed fabric as shown in figure 9 and figure 10 fabricated with 100 denier and 150 denier respectively. The change in dye shade is might be due to change in surface morphology.

## CONCLUSION

In this study the effect of frictional contact on PET filament during knitting process was observed. The results concluded that use of PET filament yarn in

knitting machine causes problems to the quality of fabric produced. When the polyester yarn passes from the heated parts, it directly affects its surface morphology. This distorts the appearance of developed fabric and significantly changes the surface reflections which is also prominent in dye take up i.e., shade variation in fabric after dyeing. The results suggested installation of heat dissipating systems on the knitting machines which are working in continuous operation mode using thermally resistive polymer yarns to avoid change in surface appearance. This effect is more prominent in summer due to elevated temperature of knitting production floor.

## ACKNOWLEDGEMENT

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# An investigation of the thermo-mechanical fusing process of innovative textile materials

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## ABSTRACT – REZUMAT

### An investigation of the thermo-mechanical fusing process of innovative textile materials

*The process of thermo-mechanical fusing (TMF) is one of the major technological processes in the sewing industry. The quality of the sewing article as a whole depends largely on the effective implementation of this process. The good appearance of the finished product and the preservation of the shapes given during the operation of the product depend on the proper choice of the parameters for the TMF. It is therefore important to carry out research to optimize this process. On the other hand, new and different textile materials (TM) with more complex structure and multicomponent composition have appeared in recent years. This determines the different properties of each TM. Therefore, it is extremely important to conduct numerous preliminary studies and analyses to determine the specific effective values for defining the TMF process for a particular type of TM. This is especially important namely for large-scale companies. In the context of the above, it is of particular interest to study the TMF process for an innovative TM (with complex structure and multicomponent composition) registered with a patent for an invention in recent years. The purpose of the present work is to investigate and analyse the nature of the change in temperature between basic and adhesive TM in TMF of innovative /complex in composition and structure/TM. As a result of the performed research and analysis, a method for establishing continuous feedback with the processed textile materials at TMF has been proposed. The nature of the temperature change of the treated innovative TM has been defined. The relationship between the time for conducting the TMF process and the temperature of the pressing plate for the respective innovative TM has been established.*

**Keywords:** thermo-mechanical fusing, innovative textile materials

### O analiză a procesului de fuziune termo-mecanică a materialelor textile inovatoare

*Procesul de fuziune termo-mecanică (TMF) este unul dintre procesele tehnologice majore din industria de îmbrăcăminte. Calitatea articolului de îmbrăcăminte în ansamblu depinde în mare măsură de implementarea eficientă a acestui proces. Aspectul corespunzător al produsului finit și păstrarea formelor date în timpul utilizării produsului depind de alegerea corectă a parametrilor pentru TMF. Prin urmare, este important să se efectueze cercetări pentru a optimiza acest proces. Pe de altă parte, în ultimii ani au apărut materiale textile (TM) noi și diferite, cu structură mai complexă și compoziție multicomponentă. Aceasta determină diferitele proprietăți ale fiecărui TM. Prin urmare, este extrem de important să se efectueze numeroase studii și analize preliminare, pentru a determina valorile efective specifice pentru definirea procesului TMF, pentru un anumit tip de TM. Acest lucru este deosebit de important, în special pentru companiile mari. În contextul celor de mai sus, este deosebit de interesant să se studieze procesul TMF pentru un TM inovator (cu structură complexă și compoziție multicomponentă) înregistrat cu brevet de invenție în ultimii ani. Scopul prezentei lucrări este de a investiga și analiza natura schimbării de temperatură între TM de bază și cel aderent în TMF-ul complex/inovator în compoziție și structură/TM. În urma cercetărilor și analizelor efectuate, a fost propusă o metodă de stabilire a feedback-ului continuu cu materialele textile prelucrate la TMF. A fost definită natura schimbării de temperatură a TM inovatoare tratate. S-a stabilit relația dintre timpul de desfășurare a procesului TMF și temperatura plăcii de presare pentru respectivul TM inovator.*

**Cuvinte-cheie:** fuziune termo-mecanică, materiale textile inovatoare

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## INTRODUCTION

The process of thermo-mechanical fusing (TMF) is one of the major technological processes in the sewing industry. The quality of the sewing article as a whole depends largely on the effective implementation of this process. The good appearance of the finished product and the preservation of the shapes given during the operation of the product depend on the proper choice of the parameters for the TMF. It is therefore important to carry out research to optimize

this process [1]. The main parameters to be optimized are the duration of the process, the temperature of the pressing plates, the temperature of the processed textile materials (TM) and the pressure. The limits of these parameters are usually given by the manufacturers of the respective adhesive/auxiliary/materials. However, it should be noted that the limit values given are relatively wide. The choice of the specific value for the respective factor is made by the operator of the machine or the technologist. This

choice is made on the basis of numerous preliminary experiments and the experience and the sense of the worker concerned. This creates certain conditions for influence of the subjective factor on the quality and performance of TMF. Therefore, the choice of the appropriate levels of the factors should be made on a scientific basis [1–3].

Many world-renowned companies are addressing these issues, but the results remain commercial or confidential. Several studies have been performed to determine the maximum temperature value of TM at TMF [4]. However, the nature of the change in temperature of textile materials during the process has not been sufficiently clarified yet.

The study of the temperature change of the TM in the TMF process is especially important for modern high technology for the production of wearable antennas [5], as well as for other technological processes.

On the other hand, new and different TM with more complex structure and multicomponent composition have appeared in recent years. This determines the different properties of each TM. Therefore, it is extremely important to conduct numerous preliminary studies and analyses to determine the specific effective values for defining the TMF process for a particular type of TM. This is especially important namely for large-scale companies.

Hence, it is necessary to expand and deepen the studies of the TMF process, taking into account the multicomponent nature and complexity of the structure of basic TM (which are subject to adhesion). In the context of the above, it is of particular interest to study the TMF process for an innovative TM (with a multicomponent composition and complex structure) registered with a patent for an invention [6] in recent years. This TM has not been a subject of scientific research regarding the TMF process.

To this end, it is important to look for effective and easily applicable methods of conducting these studies in real production conditions.

## EXPERIMENTAL WORK

In the context of the foregoing, the purpose of the present work is to investigate and analyse the nature of the change in temperature between basic and adhesive TM in TMF of innovative /complex in composition and structure/TM.

### Conditions to execute the experiment

The temperature between the basic and the auxiliary TM is  $T_M$  (material temperature). It is measured at point 1 given in figure 1.

For the present work two main experiments were performed in order to determine the nature of the change in this temperature/Experiment 1 –  $E_1$  and Experiment 2 –  $E_2$ .

After conducting a number of preliminary studies, the following general conditions were chosen to perform the two experiments/ $E_1$  and  $E_2$ :

- press for thermo-mechanical fusing Atlas - I. Bala - 4-93 - stationary press type “drawer”;

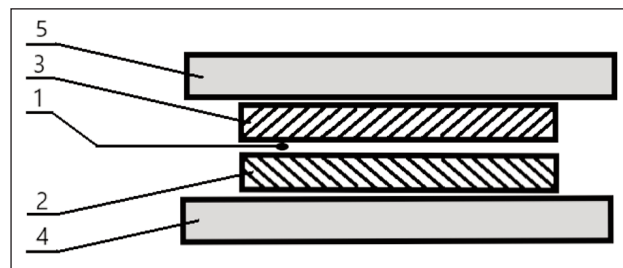


Fig. 1. Scheme of available textile materials examined: 1 – measurement point; 2 – basic TM; 3 – auxiliary/adhesive/TM; 4 – lower plate of the press; 5 – top plate of the press

- temperature of the pressing plate –  $T_P = 120^\circ\text{C}$ ;
- pressure of the pressing plate –  $P = 10 \text{ N/cm}^2$ ;
- reading the temperature was carried out every 2 seconds.

The specific difference between the two experiments is in the methods for reading the temperature  $T_M$ . A third experiment/Experiment 3 –  $E_3$  was performed to establish the relationship between the time taken for the TMF process and the temperature of the pressing plate.

The third experiment was performed with the same press and with the same pressure of the pressing plate –  $P = 10 \text{ N/cm}^2$ .

## Materials

The textile material studied is a double woven fabric (for winter sports, hunting and tourism) “Hunter 12”, produced by “E. Miroglia SA” – Sliven, Bulgaria. Flexible textile product is a fabric of multilayer weave type “double fabric”. The considered pattern consists of 2 classical twills – 3/1 twill for the face fabric and 2/1 twill for the reverse fabric. Between the face fabric and the reverse fabric there is an intermediate bonding layer of chemical threads.

Pure cotton fibres (100%) make the face layer of the fabric and 100% wool fibres make the reverse layer of the fabric. The intermediate layer is made of chemical fibres – polyamide and viscose [6, 7]. General fibrous composition of the face fabric is characterized by the linear density of warp threads  $Tt = 20.0 \times 2 \text{ Tex}$ , Sirospun, 70%/18%/7%/5% – Cotton/Viscose/PES PA6, while the linear density of weft threads is  $Tt = 16.1 (8.3 + 7.8 \text{ Ply twisted}) \text{ Tex}$ , 52%/48% – Viscose/PES. General fibrous composition of the reverse fabric is characterized by the linear density of warp threads  $Tt = 16.1 (8.3 + 7.8 \text{ Ply twisted}) \text{ Tex}$ , 52%/48% – Viscose/PES, while the linear density of weft threads is  $Tt = 40 \times 1 \text{ Tex}$ , 100% Wool [6, 7].

It was the multicomponent composition, the complexity of the structure, and the remarkable applicability of the above-described TM that aroused interest in exploring the conditions for the implementation of its thermo-mechanical sticking.

The textile material described is used as a basic material.

For adhesive textile material/auxiliary textile material/ was used material produced by the company Kufner

– B121N77. The adhesive TM is tissue, with Surface Mass – 63 g/m<sup>2</sup>, warp threads – 100% PES, weft threads – 100% PES.

### Methods

In the TMF process, apart from the temperature of the pressing plate, it is especially important to take into account the  $T_M$  temperature. Generally, in manufacturing companies this temperature is registered with thermal paper. Thermo-paper registers the maximum temperature reached by the auxiliary TM, but it is not possible to trace the nature of this temperature change during the whole technological process more precisely. In this regard, two parallel experiments were conducted for this study in order to investigate the nature of the temperature change  $T_M$ .

In the first experiment  $E_1$  the temperature was registered with thermal paper and in the second experiment  $E_2$  the temperature was registered with a computer-integrated measurement system [8].

This will allow a comparative analysis between the two methods of study.

The  $T_M$  temperature at which a sufficiently secure connection is made between the basic and the adhesive TM is established after conducting a number of preliminary experiments.

For this purpose, the quality criterion is the strength of the connection between the primary and the adhesive TM. If when attempting to separate the main from the adhesive TM breaks the integrity of the adhesive TM (the adhesive TM tears), therefore the strength of the bond made is greater than the tearing strength of the adhesive TM.

In the present work, this criterion is taken as a proof that the bond made is sufficiently reliable and efficient. This criterion is relatively quick and easy. This is the reason why it was proposed to be used as a method of work in conducting this research.

## RESULTS AND DISCUSSIONS

### Experimental results

After numerous preliminary experiments, the temperature at which the polymer binder established a sufficiently reliable bond between the base and the adhesive TM (according to the above quality criterion) was found to be 112°C. It is assumed that this is the temperature  $/T_Q/$  required for quality adhesion when handling the textile materials described.

Therefore, in the present work it is considered necessary to finalize the adhesion process when condition 1 is fulfilled:

$$T_M = T_Q = 112^\circ\text{C} \quad (1)$$

In this regard, the first experiment was carried out until the thermal paper reads the first temperature higher than 112°C.

The experiment results  $E_1$  are illustrated in figure 2. The second experiment was performed until  $T_M$  reached 112°C. The experiment results  $E_2$  are illustrated in figure 3.

### Discussion of experimental results

It is necessary to check the process of reproducibility that is reduced [9, 10] to checking the variance perseverance (by Cochran's C test):

$$G_C = \frac{S_{i\max}^2}{\sum_{i=1}^B S_i^2} \quad (2)$$

$$G_T \{f_1 = m-1; f_2 = B; r = 0.05\} \quad (3)$$

where  $m$  is the number of repeated trials for each variant,  $B$  – number of variant,  $f_1$  and  $f_2$  – degrees of freedom,  $r$  – significance level.

The process of reproducibility was checked for each experiment  $E_1$ ,  $E_2$ , and  $E_3$ .

The results for the calculated and tabulated value of the Cochran's C test for Experiment 1 are:

$$G_{C,1} = 0.91798; \quad G_{T,1} = 0.9750 \quad (4)$$

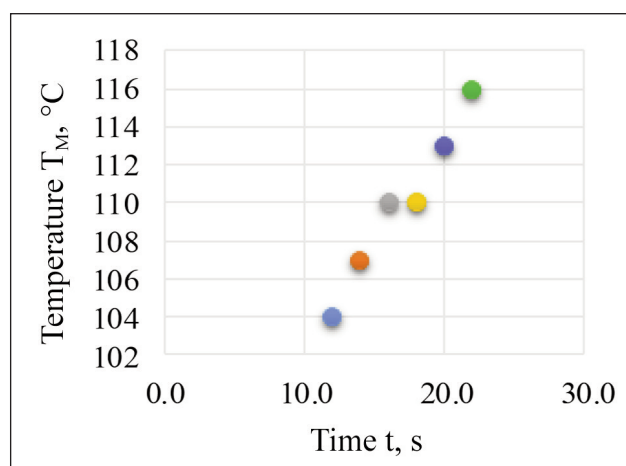


Fig. 2. Time-temperature dependence for Experiment 1

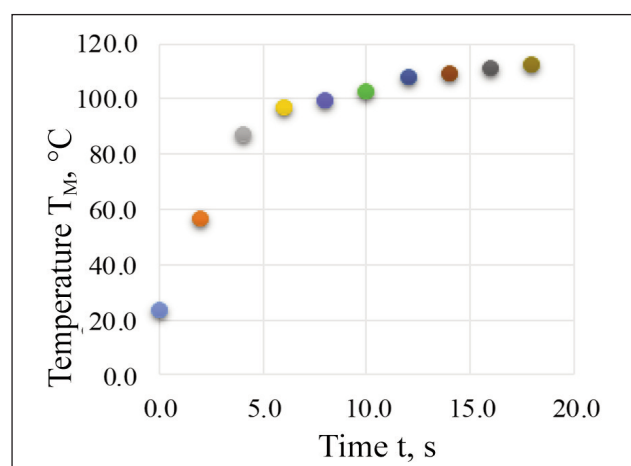


Fig. 3. Time-temperature dependence for Experiment 2

Therefore, intra-group variance does not differ statistically and the study process for Experiment 1 is reproducible [10].

It can be summarized that the process is reproducible, but there is no clear idea of what the exact temperature  $T_M$  is at any given moment. This is due to the fact that the temperature reading interval when using thermal paper is 4–6 °C.

The temperature may be 109 °C at the time of opening the press, but the thermal paper reads 104 °C /the next temperature indicated on the thermal paper scale 110 °C has not been reached/. This discrepancy between the factual TM temperature and the reported  $T_M$  when using thermal paper makes it extremely difficult to work precisely in the sewing industry. There are conditions for the influence of the subjective factor on the management of the process of adhesion in real production. Furthermore, any scientific research in this area (using thermal paper) is not sufficiently precise.

This is unacceptable in the present-day conditions of development of industrial technologies.

In the light of the above, the present work suggests that the temperature  $T_M$  be recorded with a computer-integrated measurement system [8].

The system is designed to investigate the damp-heating processing [8]. In conducting many preliminary experiments of the TMF process, it has been found out that it /the system/ can find an extremely effective application in investigating this technological process as well.

Therefore, a second parallel experiment was conducted to determine the nature of the temperature change  $T_M$  using a computer-integrated measurement system [8] instead of thermal paper. This measurement method provides direct contact with the processed TMs and continuous feedback with them. Through the communication interface RS485 [8], the temperature measurement data  $T_M$  are transferred to a computer database.

The results for the calculated and tabulated value of the Cochran's C test for Experiment 2 are:

$$G_{C,2} = 0.731019; \quad G_{T,2} = 0.9392 \quad (5)$$

Therefore, the study process for Experiment 2 is reproducible.

The results of Experiment 2 clearly illustrate the nature of the change in temperature  $T_M$ . Conclusions about the stages of the TMF process that takes place with closed press plates can be drawn from the analysis of the obtained results.

In the range to 97–98 °C the temperature rises relatively quickly, for 6–7 s. This paper assumes that this is the first stage of the process. The upper press plate directly transmits heat to the top/adhesive/textile material. It is heated to the point where the entire surface layer reaches 97–98 °C. In the 97–100 °C interval, a relatively slower rise in temperature is observed. Despite the short period of time (from 7th

to 9th seconds), the  $T_M$  temperature is approximately constant. This corresponds to a constant drying rate, therefore according to [11], it corresponds to the removal of hygroscopic moisture from the surface layer. The present work assumes that this is the second stage of the process. Above 100 °C the temperature begins to rise more intensively. In the interval between 105–110 °C again it slightly decreases the rate at which the temperature  $T_M$  rises. The present work assumes that this is the temperature interval at which the polymer binder passes in a viscous liquid state. This melting process takes away some of the energy and therefore reduces the rate of temperature increase. This is considered to be the third stage of the process.

As a result of the analysis, the main stages of the adhesive process are formulated:

- first stage – for temperature range: 23 °C – 97 (98) °C – stage of total heating of the surface layer of the treated TM;
- second stage – for temperature range: 97 (98) °C – 100 °C – stage of removal of hygroscopic moisture from the surface layer of the treated TM;
- third stage – for temperature range: 100 °C –  $T_Q$  °C (melting point of the polymer binder).

$T_Q$  depends on the type of adhesive textile material and on the type of the basic TM. Therefore, for different types of treated TM, the temperature  $T_Q$  will be different.

A third experiment was performed to establish the relationship between the time of the TMF process and the temperature of the pressing plate. The experiment results are illustrated in figure 4.

The criterion for finalizing the process (for opening the pressing plate) is the fulfilment of condition 1.

The results for the calculated and tabulated value of the Cochran's C test for Experiment 3 are:

$$G_{C,3} = 0.731019; \quad G_{T,3} = 0.9392 \quad (6)$$

Therefore, the study process for Experiment III is reproducible.

The results show that with increasing the temperature of the pressing plate, the time for the TMF process implementation decreases.

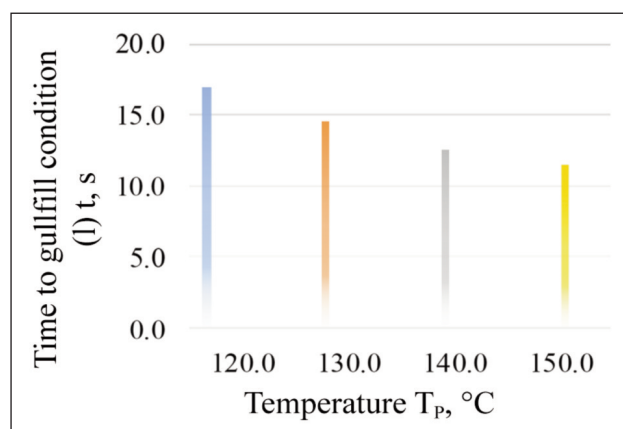


Fig. 4. Time-temperature dependence for Experiment 3

## CONCLUSIONS

This paper has examined one of the major technological processes in the sewing industry – the TMF process. The research was carried out with innovative TM.

As a result of the performed research and analysis, a method for establishing continuous feedback with the processed textile materials at TMF has been proposed. This creates the conditions for more detailed research and management of this technological process.

A criterion for finalizing the TMF process has been proposed. The nature of the temperature change of the treated innovative TM has been defined. As a result, the formulation of the different stages of the TMF process has been proposed. The relationship between the time for conducting the TMF process and the temperature of the pressing plate for the respective innovative TM has been established.

The results obtained are a good basis for clarifying the nature of the TMF process and create the conditions for its management and automation.

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# Impact of consumer Attitude towards purchase intention of the counterfeit products: a multigroup analysis between the user and non-user

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## ABSTRACT – REZUMAT

### Impact of consumer Attitude towards purchase intention of the counterfeit products: a multigroup analysis between the user and non-user

*The purpose of this study was to investigate the factors which influence a consumer's decision to buy counterfeit products. The factors are Attitude towards counterfeits by economic benefit, Attitude towards counterfeits by Hedonic benefits, Subjective norm and Perceived behaviour control and their impact on the purchase intention of the textile/clothing counterfeit product was analysed. A total of 120 questionnaires were distributed. Data was analysed using IBM Statistics 3.0. and SMART PLS. Attitude towards counterfeits by economic benefit and Perceived behaviour control had strong relationships with purchase intention of counterfeit products. Attitude towards counterfeits by Hedonic benefits didn't show any significant relationship with purchase intention. Subjective norm had strong positive relationship with purchase intention of counterfeits. This study is useful for Developing Countries, especially in Impact of theory of planned behaviour on the purchase intention of the counterfeits and is examined on the user and non-user of the counterfeit product.*

**Keywords:** Hedonic benefits, Subjective norm, Perceived behaviour control, purchase intention, counterfeit products

### Impactul atitudinii consumatorului față de intenția de cumpărare a produselor contrafăcute: o analiză multigrup între utilizator și non-utilizator

*Scopul acestui studiu a fost de a investiga factorii care influențează decizia consumatorului de a cumpăra produse contrafăcute. Factorii sunt Atitudinea față de produse contrafăcute prin beneficii economice, Atitudinea față de produse contrafăcute prin Beneficii hedonice, Norma subiectivă și Controlul comportamentului perceput și s-a analizat impactul acestora asupra intenției de cumpărare a produsului de îmbrăcăminte contrafăcut. Au fost distribuite în total 120 de chestionare. Datele au fost analizate utilizând IBM Statistics 3.0. și SMART PLS. Atitudinea față de produse contrafăcute prin Beneficiul economic și Controlul comportamentului perceput au avut relații puternice cu intenția de cumpărare a produselor contrafăcute. Atitudinea față de produsele contrafăcute prin Beneficii hedonice nu a arătat nicio relație semnificativă cu intenția de cumpărare. Norma subiectivă a avut o relație puternică pozitivă cu intenția de cumpărare a produsului contrafăcut. Acest studiu este util pentru țările în curs de dezvoltare, în special în Impactul teoriei comportamentului planificat asupra intenției de cumpărare a produselor contrafăcute și este analizat pe utilizatorul și non-utilizatorul produsului contrafăcut.*

**Cuvinte-cheie:** Beneficii hedonice, Norma subiectivă, Controlul comportamentului perceput, intenția de cumpărare, produse contrafăcute

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## INTRODUCTION

Counterfeit product is a worldwide concern that causes major economic and social problems [1]. The trade of counterfeit product is calculated at \$500 billion worldwide and it is around 5% to 7% of the all world trades [2]. However \$268.2 (63%) billion represents the U.S. trade share of the counterfeit goods [3]. While ICC (International Anti-counterfeiting Coalition) stated in its report that loss of more than \$200 billion and 75000 jobs in United States is due to the counterfeit goods and piracy [4]. New York have annual estimated sale of the counterfeit good of \$23 billion and this causes \$1 billion decrease in tax revenue

annually [3]. Counterfeit goods are a major threat for new arrival brand product [5]. Due to high presence of counterfeit goods in the market, counterfeiting is a market which produces fake products similar to the original brand product. This fact increases the sale of the products at a shocking rate [6]. However, the Attitude towards counterfeit good that leads to the purchase intention of the counterfeit good lie in relation to the study of Liao et al. [7]. Many research and study focus on the purchase intention of the counterfeit goods but mostly should focus on the supply side of the counterfeit goods [8, 9]. While Pakistan is the biggest market for counterfeit goods, the quantity of

research work done on the other part of demand supply is insufficient. The government authority and manufacturing work to detain this unlawful activity, but counterfeiting is present in the market because its sale exists. The current study focuses on: (a) to identify the Subjective norm that affects consumer motivation towards the purchase of the fashion counterfeit goods; (b) to identify the Attitude towards the counterfeits by economic benefit and used theory of planned behaviour to identify the relationship between subjective and perceived behaviour control towards the purchase of the textile/clothing counterfeit goods; (c) to identify the effect of the past purchase behaviour on the purchase intention of the fashion counterfeit goods.

## LITERATURE REVIEW

### The demand for counterfeit goods

The study of the counterfeit goods is growing rapidly throughout the world. There are many predictors of the counterfeits which have identified the impact of the buying intention of the counterfeits, such as Subjective norm (social status, social cost and value consciousness) [10]. While Perceived behaviour control is made-up to imitate user of the product. Counterfeits are the market and the manufacturing of the product which looks similar to the original product [6]. However, the ever consumption of the different variable such as economic, social and political and implications of the marketing in this field have attracted researchers.

### Purchase intention of the counterfeit product

The most popular way to examine the purchase intent of the counterfeit good is the attitude of the consumer towards the counterfeit goods [11] describe attitude as an "a person's overall evaluation concept". It is also referred to be the portion of a person's character. Researchers argue that consumer education about the counterfeit can improve this situation to overcome the counterfeits sale [12–14]. The planned behaviour theory suggested that attitude should be coupled with the Subjective norm and Perceived behaviour.

### Attitude towards counterfeits by economic benefits

"Attitude is defined as the mental state individuals use to structure the ways to perceive the environment" [15, 16]. Attitude can either be positive or negative. Positive Attitude towards the counterfeit product influences the consumer's Attitude towards the second purchase of the counterfeit product.

H1: Impact of Attitude towards counterfeits by economic benefits on the purchase intention of the counterfeits.

### Attitude towards counterfeits by Hedonic benefits

Attitude is an aspect to forecast intentions and behaviour of customers [14, 15–18]. The Attitude

towards counterfeit goods is also seen as a factor and has an important influence to the idea of buying counterfeit goods [19, 20]. So the Attitudes towards counterfeit goods are a dynamic factor to predict the intention of buying counterfeit goods, especially for Hedonic benefits [21]. There is a positive relationship between favourable attitudes and intention to purchase towards counterfeiting goods [18–26].

H2: Impact of Attitude towards counterfeits by Hedonic benefit on the purchase intention of the counterfeits.

### Subjective norm

The correlation between Subjective norms and Attitudes towards behaviour was examined more thoroughly, and tested the causal link from norms to attitudes. Chang [27] suggested that the link could be explained with social environment's influence on an individual's attitude formation. Subjective norm is a social factor referring to the perceived social pressure to perform or not to perform a given behaviour [18]. Consumers may be informationally susceptible, when expertise from others influences their choice (e.g. when one does not know the product category), and also normatively susceptible, when they are more interested in making a good impression to others [28].

H3: Impact of the Subjective norm on the purchase intention of the counterfeit product.

### Perceived behaviour control

Perceive behaviour control has less impact on the purchase intention. The e-commerce has reduced the importance of the Perceived behaviour control as many consumers of the counterfeit product buy them from the internet. Ajzen [18] added an additional variable, Perceived behavioural control, to the original TRA model to address this problem. Perceived behavioural control is individual's perception of their ability to engage in the certain behaviour [18]. Perceived behavioural control is a combination of control beliefs and perceived power. Control beliefs are the presence of opportunities or resources for facilitating or interrupting the performance of behaviour [18].

H4: Impact of the Perceived behaviour control on the purchase intention of the counterfeits.

### Theoretical framework

Theory of planned behaviour [18] describes how an individual's made Attitude towards purchased behaviours. In this theory, intentions are defined as act towards any product in specific way [17] and Subjective norms refer to perceived social pressure to perform or not performs the behaviour [18]. This study uses four independent variables i.e., Attitude towards counterfeits by economic benefit (ATCEB), Attitude towards the counterfeits by Hedonic benefits (ATCHB), Purchased behaviour control (PBC) and Subjective norm (SN). While the moderator variables are past purchase (figure 1).

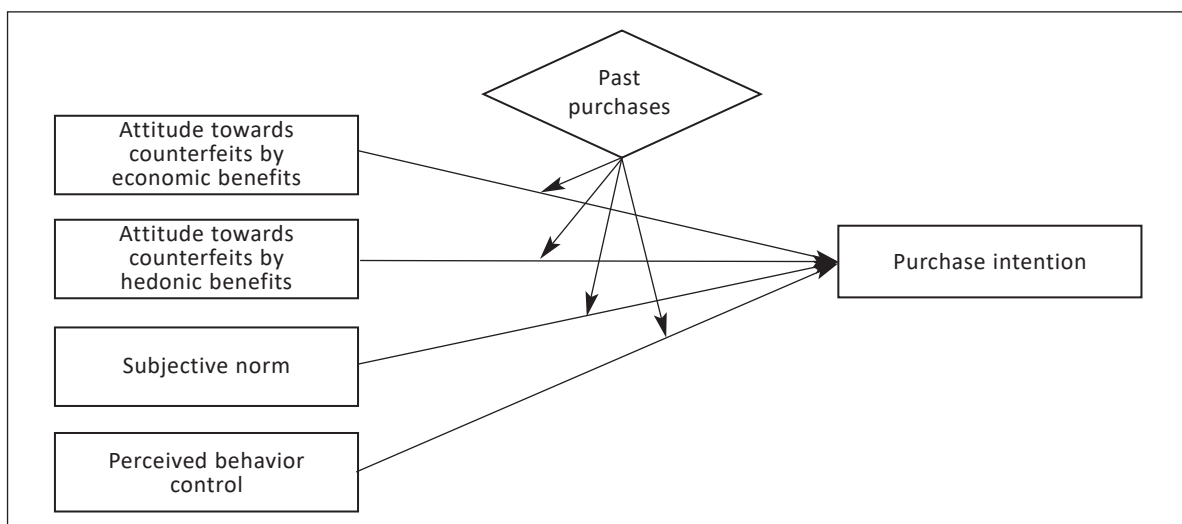


Fig. 1. Theoretical frame work

## METHODOLOGY

The study used quantitative research methodology. For this purpose, primary data was collected from the 250 consumers, who used counterfeit product to know their buying experience after purchasing one time counterfeits product in Pakistan.

The questionnaire used five scales that included (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree and 1 = strongly disagree). However, Attitude towards counterfeits by economic benefit and Hedonic benefit are measured by Kirkwood-Mazik [29]. Subjective norm was measured by the Marcoux et al. scale [30]. Three product design were developed for this study. Perceived behaviour was measured by the Lichtenstein et al. [31]. Past purchase behaviour was measured by nominal scale (0 = No, 1 = Yes). Purchase intent (PI) for counterfeit goods was measured using five items that were adapted from Beck and Ajze [32].

## PROCEDURE FOR DATA ANALYSIS

Statistics analysis was done at National Textile University, Faisalabad Pakistan. The supervisor and the researcher were involved in the planning, analysing and execution of data analysis. Data was analysed by using descriptive statistics. IBM SPSS Statistics was used to analyse data. For exact relationship among variable, validity of construct is extremely important and it is depended upon the researcher ability to properly measure the variable.

## Data analysis and result

Below tables shows that different variable dependent, moderating variable and independent variables. These variables should be used to find the answer of the research question.

## Reliability and validity analysis

The reliability of this model was checked through the factor loading and composite reliability. All the value of the factor loading and composite reliability should be exceeded from the minimum value that is 0.7. The

validity of model assessed through convergent validity and discriminant validity. However, the convergent validity model was determined by AV and CR, all value of CR and AVE must be greater than 0.5 and 0.7 respectively (figure 2).

## Discriminant validity

For discriminant of the variables researcher have taken the square root of each value to find the AVE average variance extended that exceeded the inter-correlation developed with inter-correlation of the developed with alternate forum in the model to guarantee discernment validity (table 1) [33].

Table 1

DISCRIMINATE VALIDITY					
Variables	CEB	CHB	PBC	PI	SN
CEB	0.780				
CHB	0.748	0.758s			
PBC	0.757	0.708	0.690		
PI	0.768	0.645	0.724	0.732	
SN	0.716	0.745	0.640	0.672	0.769

## Structural model estimation

According to Hair et al. [34] and Henseler et al. [35], the  $R^2$  is a measure of the predictive accuracy of the model. While according to Hair et al. [36], the Cross Validated redundancy  $Q^2$  method should be used for measuring predictive Relevance of inner model. While contrasting the  $Q^2$  IS greater than zero is indicative for a specific inductive of whatever an endogenous build can be anticipated, it does not say anything about the quality of the prediction (table 2 and figure 3).

Table 2

STRUCTURAL MODEL ESTIMATION		
Variables	R Square	R square adjusted
PI	0.654	0.643



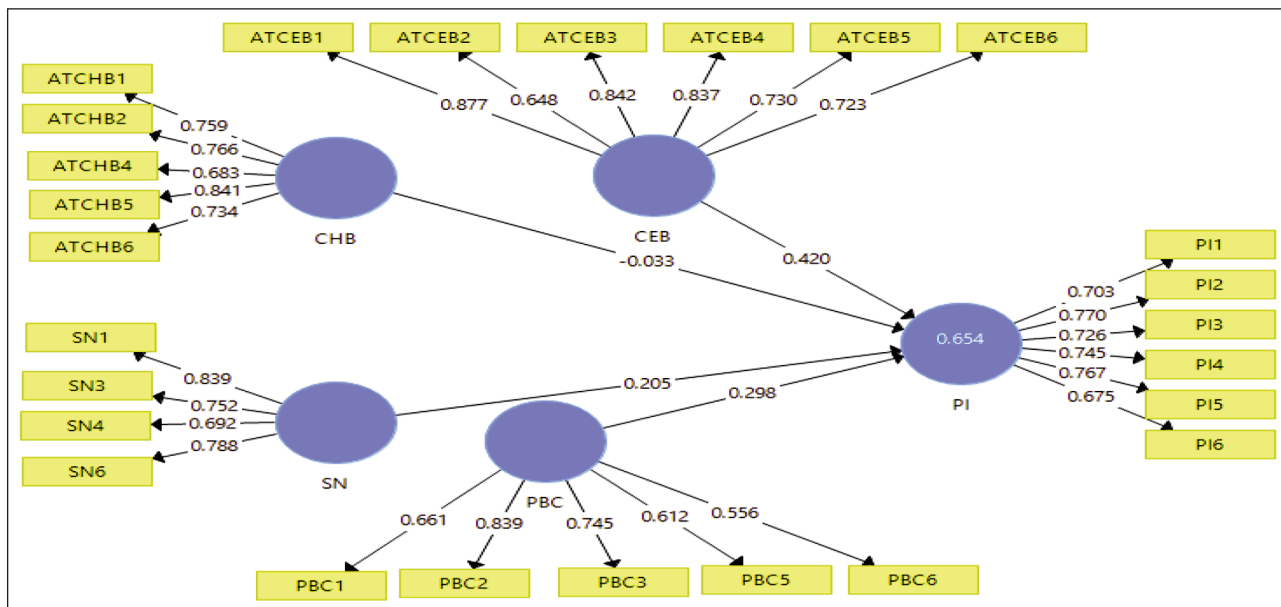


Fig. 2. Reliability analysis

### Complete (user and non-user of counterfeits)

The impacts of Attitude towards counterfeits have economic benefits on the purchase intent of the counterfeit product. However, table 3 illustrates the finding of the H1. Hypothesis 1 is that impact of the Attitude of the counterfeits by economic benefit on the purchase intent of the counterfeit product, as per our finding ATCEB have a significant impacts on the purchase intent of the counterfeit product showing Hypothesis 1 was supported ( $\beta=0.420$ ,  $t\text{-value}=0.417$  and  $p\text{-value}=0.002$ ).

Hypothesis 2 the Attitude towards counterfeits by Hedonic benefit has impacts on the purchase intent of the counterfeit product. As per finding ATCHB has significant no impact on the purchase intent of the counterfeit product. Hypothesis 2 was not supported ( $\beta = -0.03$ ,  $t\text{-value} = -0.024$  and  $p\text{-value} = 0.844$ ).

Hypothesis 3 the Subjective norm of the counterfeits

Table 3

FINDING OF THE H1			
Hypothesis	Complete	User	Non-user
ATCEB $\rightarrow$ PI	0.417	0.615	0.127
ATCHB $\rightarrow$ PI	0.033	-0.0273	0.235
SN $\rightarrow$ PI	0.205	0.251	0.229
PBC $\rightarrow$ PI	0.298	0.354	0.259

has impact on the purchase intent of the counterfeit product. As per finding SN has significant impact on the purchase intent of the purchase intent of the counterfeit product. Hypothesis 3 was supported ( $\beta = 0.205$ ,  $t\text{-value} = 0.199$  and  $p\text{-value} = 0.013$ ).

Hypothesis 4 the Perceived behaviour control of the counterfeits has impacts on the purchase intent of the counterfeit product. As per finding PBC has

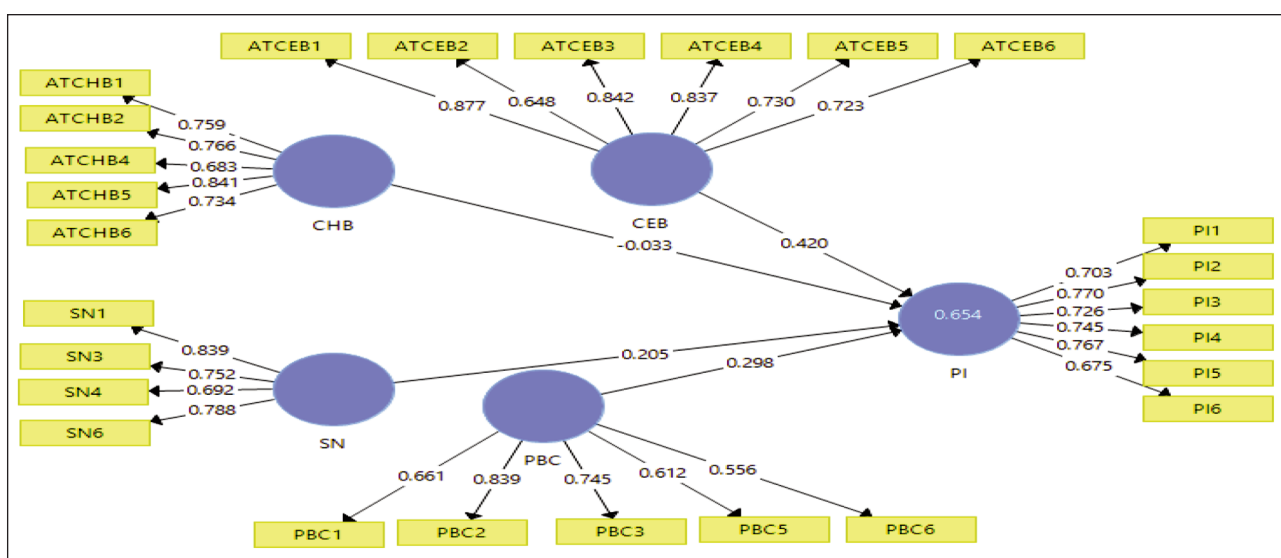


Fig. 3. PLS-Bootstrapping

HYPOTHESIS RELATIONSHIP					
Hypothesis	Path coefficient	t-value	p-value	Excepted impact	Decision
H1	0.420	0.417	0.02	+	Supported
H2	-0.033	-0.024	0.844	-	Not supported
H3	0.205	0.199	0.013	+	Supported
H4	0.298	0.3	0	+	Supported

significant impact on the purchase of the counterfeit product. Hypothesis 4 was supported ( $\beta = 0.289$ ,  $t$ -value = 0.300 and  $p$ -value = 0.000) (table 4).

## DISCUSSION AND CONCLUSION

As predictable finding of the current study has identified the impact of ATCEB, SN and PBC have a significant on the purchase intention of the counterfeits. Consumer may made purchase intention towards the fashion counterfeits because the Perceived behaviour may look similar to the authentic goods. People who purchase fashion counterfeits in the past have positive Attitude towards buying the buying fashion counterfeits. The result suggests that people may buy fashion counterfeits usually. Gentry et al. [37] found that tourists, both Caucasians and Asians, are the main customers of fashion counterfeit goods.

When buying fashion counterfeits becomes habitual, it may be further difficult to depress the behaviour. Therefore, it is significant for the government and authorities to bound opportunities and resources (counterfeit selling district) to buying fashion counterfeit goods. The U.S. Custom may develop an educational movement at the airports to deliver people an opportunity to think about ethical matters and negative concerns related to counterfeit goods.

The sale of the counterfeits is large due to large scale of counterfeits present in a market. It is difficult to control them and controlling scale of the counterfeits causes loss of the millions of the job that are associated either the sale and the purchase of the fashion counterfeits. This finding is reliable with earlier studies that inspected other product groups such as music CDs, clothing, and software [18, 34–40].

This finding clearly implies that counterfeit consumers are very probable to become final consumers for originals completed time and do not return to counterfeits, a possibility that is reliably found in pirated software or illegal music file transferring research, where counterfeits assistance a full and fast market diffusion of the prototypes [41]. Similarly, fashion counterfeits might function as a risk-free trial form, make attention among customers, and make them feast positive word-of-mouth to other consumers.

It is been for a long time that counterfeits manufacturing supply has been under examination and the people and the institution finding a way to overcoming this activity. But now researcher has shifted their focus that if counterfeit product is produced in the large rate, then it means its demand exist. This study

focuses on the consumer's attitude and purchase intention of the counterfeits. This study was based on the user and the non-user of the counterfeit product. For this purpose, a model was adapted which had three independent variables, namely Attitude towards the counterfeits by economic benefit, Attitude towards the counterfeits by Hedonic benefit and subjective and the other is Perceived behaviour control with a moderator past purchase and the dependent variables is purchase intention of the counterfeit product. To produce results that provide dynamic information, broad literature has been presented that supports this study and gives comprehensive base. On the other hand, effective analysis techniques have been discussed in methodology section to increase the validity of this study. This study concluded that Attitude towards counterfeits by economic benefit and Perceived behaviour control had strong relationships with purchase intention of counterfeit products. Attitude towards counterfeits by Hedonic benefits didn't show any significant relationship with purchase intention. Subjective norm had strong positive relationship with purchase intention of counterfeit. Conceptual framework in this study was adapted from exploratory study of Kim and Karpova [42] and this study tested the prepositions given in that study and also explored other relationships.

## CONTRIBUTION OF STUDY

The current research has several contributions in the context of original textile brand producers and local users, as well as also helps the policy makers to fight against the increasing trends of sale of duplicating goods, hindering the safety and financial condition of the country. The study contributed to the general public and the consumer of the counterfeit product focusing not only the purchase intention of the counterfeit product but also change in customer buying behaviour after the first purchase of the counterfeit product. Consumer past purchase behaviour has a positive Attitude towards buying the fashion counterfeits, endorsing the consequences of d'Astous and Saint-Louis [43]. This research helps the government and the brand to know the factor behind the purchase of the counterfeit product. This will also help the private brand to fight against the counterfeit product. By investigating the factor behind the purchase of the counterfeit product, private enterprises can have increased the sale of their brand by improving it. In this study Hedonic benefit signifies the impact of the

purchase intention of the counterfeit product. An importance that consumer who buy counterfeit luxury product he can get pleasure for some time but they don't give long time pleasure to customer as compared to brand product provided.

### LIMITATION OF THE STUDY

For the future research, the current study also has procedural limitations. Firstly, data in this study was collected only from the students, who studied in the public University of the Faisalabad. It can be an issue of generalizability, because the students of the public university sector in Pakistan may have changed

Attitude towards the purchase intention of the counterfeit product. It would be valuable to conduct cross-cultural and cross-industrial studies to identify the cultural influence among variables. Secondly, the study used cross section data which creates a problem on defining the cause and effect relationship between variables. Lastly, the number of students from the public university sector is equally important as the number of students from the private university sector. Therefore, it is important to compare the relationship between the public and the private university customers of textile/clothing counterfeit products.

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# Mediating role of innovative climate among leadership and employee performance in textile exporting firms of Pakistan

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## ABSTRACT – REZUMAT

### Mediating role of innovative climate among leadership and employee performance in textile exporting firms of Pakistan

*This research seeks to examine how transformational leadership and ambidextrous leadership impact employee performance. The study focuses on the mediating role of innovation climate in influencing the relationship both directly and indirectly with employee performance. Previous literature shows that many studies have been conducted to measure the employee's performance under the leadership. Still, no study has covered the mediating role of innovation climate between leadership and employee performance. The present study aims at filling that gap through the presentation of a statistical model. Respondents in the sample included the managerial staff of textile exporting firms of Pakistan. Multiple linear regression and the PROCESS for mediation model in the SPSS was used to analyze the collected data. The results indicated that the CEO transformational leadership and ambidextrous leadership had a significantly positive influence on employee performance. In addition, innovation climate was found to have a strong mediating effect. The researchers recommended the exploration of the impact of other possible moderating variables in future researches. Recommendations were also made for the top management of textile firms for the consideration of innovation climate along with the improvement of employee performance.*

**Keywords:** CEO transformational leadership, ambidextrous leadership, innovative climate, employee performance, textile export, Pakistan

### Rolul de mediere al climatului inovator privind leadershipul și performanța angajaților în firmele exportatoare de textile din Pakistan

*Această cercetare își propune să examineze modul în care leadershipul transformațional și leadershipul ambidextru influențează performanțele angajaților. Studiul se concentrează pe rolul de mediere al climatului de inovare în influențarea relației atât direct, cât și indirect a performanței angajaților. Literatura anterioară arată că au fost efectuate multe studii pentru a măsura performanța angajatului sub leadership. Cu toate acestea, niciun studiu nu a acoperit rolul de mediator al climatului de inovare dintre leadership și performanța angajaților. Prezentul studiu își propune să umple acest gol prin prezentarea unui model statistic. Respondenții din eșantion au inclus personalul managerial al firmelor exportatoare de textile din Pakistan. Regresia liniară multiplă și modelul PROCESS for mediation în SPSS au fost utilizate pentru a analiza datele colectate. Rezultatele au indicat că leadershipul transformațional CEO și leadershipul ambidextru au avut o influență semnificativ pozitivă asupra performanței angajaților. În plus, climatul de inovare s-a dovedit a avea un puternic efect de mediere. Cercetătorii au recomandat explorarea impactului altor posibile variabile de moderare în cercetările viitoare. De asemenea, au fost făcute recomandări pentru top managementul firmelor textile pentru luarea în considerare a climatului de inovare împreună cu îmbunătățirea performanței angajaților.*

**Cuvinte-cheie:** leadership transformațional CEO, leadership ambidextru, climat inovator, performanța angajaților, export de textile, Pakistan

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## INTRODUCTION

Innovation in textile firms has become the main driver of creating a competitive advantage [1]. It has led to changes in the ways textile firms compete in a single industry and has directly affected their ability to survive. The textile firms that do not innovate will probably not stay in the market for long [2, 3]. Innovation is more than newness, inventions, creativity [4, 5], which is mainly used by textile firms to present a positive image of their brands. Innovation culture helps firms to expand their business as well as attract new clients [6]. New ideas and innovative

products are straightforward to introduce in the textile sector, but launching and commercialising these ideas is challenging. As a result, most textile firms fail to take place in competitive export markets due to innovative ideas [7].

Scholars and managerial practitioners have identified leadership behaviours as the most influential drivers of innovation climate [8]. Executives can create an environment within their organizations that support innovation [6]. This includes developing the skill sets necessary for the innovation process, such as forming structures, allocating resources, putting the latest

techniques in the workplace, creating learning environments, being open to outside ecosystems, and accepting failure are considered the essential parts of learning [6]. Managerial scholars argue that the notion of an innovative leader is different from that of an innovation leader. However, some in academia and material practices still misunderstand the difference between these two concepts [9, 10]. The concept of an innovative leader relates to the leader's skills and traits. This type of leader is a source of creativity who can bring in new thinking and prescribe different actions regarding leading, managing, and moving forward with work. An innovative leader can think of different ways to overcome organizational challenges or deal with a scarcity of information [11]. In contrast, an innovation leader focuses on creating an organizational environment with a climate of innovation that supports innovation within teams. In this environment, employees can implement innovative practices that lead to new products or services [12]. In addition, an innovation leader does not just hire creative resources. Instead, an innovation leader helps teams think of new ways to capture value, work within resource constraints to develop and manage processes, achieve a competitive advantage, and ultimately organizational survival [13, 14]. Overall, a growing knowledge of leadership practices and innovation is evident among those in management and academic literature [15]. However, modern researchers argue that if a leader wants innovative and quality outcomes, he must mix different leadership skills and have strong interaction quality [16]. Thus, innovation leaders need to identify and develop the skills that are appropriate for impacting innovation. After all, they are the ones who are responsible for infusing their organizations with practices that foster employee performance [8].

This study will extend the existing body of knowledge on CEO transformational leadership and ambidextrous leadership relationships by investigating innovation climate mediation with employee performance. Moreover, it will sensitize practitioners on how CEO transformational leadership and ambidextrous leadership directly affect employee performance. Furthermore, when mediated by innovation climate, it will inform them about the remedial measures against the effects of leadership on innovation. Finally, it will also provide a basis for further investigation on different dimensions of leadership in an organization.

This study investigates the direct positive relationships between CEO transformational leadership, ambidextrous leadership, and employee performance. In addition, it checks the mediating role of innovation climate among CEO transformational leadership, ambidextrous leadership, and employee performance. The unit of analysis of this study is the managerial staff of textile exporting firms in Pakistan.

## Literature review

### The role of CEO transformational leadership

A transformational leader can be defined as “a dynamic person who is far away from personal interests, having a charismatic and influential personality, having the inspirational ability, an intellectual with unique ideology” [17]. A transformational leader can see in the future and save his organization from recessions and use his ability to achieve the organization's goal. In the presence of a transformational leader, his followers' expectations and enthusiasm increased as their leader set the organization's goal achievable, rational and tangible. To get innovative outcomes, leaders need to adopt a transformational style that will help them explore new ideas [18]. When leaders adopt the transformational style, it allows organisations to explore innovation, create a learning environment for employees, improve safety standards, think positively, rectify errors, and improve employee empowerment by using positive behaviour. As a result, the innovative climate of an organization can be enhanced with the implementation of all these elements [3, 19].

### The role of ambidextrous leadership

Ambidextrous leadership is a new leadership theory that was put forth by German strategy professors [11]. Funded by Volkswagen information technology company, O'Reilly and Tushman [11] conducted a comprehensive research study which implemented a meta-analysis of existing literature that linked leadership effectiveness with innovation performance. [20] focused on determining the behaviours that influenced business innovation most effectively and looked explicitly at leaders who had direct contact with innovation teams. The dilemma related exclusively to the two ends natures of the innovation process, which are creativity and implementation. They require opposing and contradicting leading behaviours (i.e., opening and closing behaviours) [21]. Determining the complementary leadership behaviours necessary for innovation and how team leaders can help teams and individuals implement them and become more innovative was a significant concern [22, 23].

Rosing et al. [20] discussed that ambidextrous leadership performs well in an organisation that promotes innovative culture because it can work under opposite and diverse situations in the same manner. Opening behaviours encourage new experiments after unique ideas. It leads to setting up new manners to fulfill assigned tasks, promote risk taking, encourage to execute new ideas and learn from mistakes [24]. On the other hand, closing behaviours support discriminating policies at the implementation stage. It refers to coaching, goal achievement, setting up new goals, performance enhancement programs, dedication to following the rules, minimising errors, and implementing plans. Investigations show that creativity and control are opposite between the teams [18], and the leaders who were capable of adopting an innovative environment in the organization were very

reluctant. They can level up between both behaviours according to the project's demand [25, 26].

Innovation occurs in two levels: the organizational level and the team level [27]. Therefore, the complexity of innovation leadership is feed by the overlapping roles and activities that depend on the hierarchy of an organization. Leaders should employ a transformational leadership style to influence organizational innovation, whereas team leaders should use ambidextrous leadership to respond to variations in innovation outcomes [26].

### The mediating role of innovative climate

Soken et al. [28] claim that in organizations, executives benefit from innovation environments. However, an innovation that enables organizational climate is not created by chance. It results from an organization's strategy, a supportive culture, and influential leaders willing to learn from failure. According to a worldwide survey [29, 30], over 94% of executives indicated that people and climate are the two most important drivers of innovation in organizations. They put human capital at the centre of their strategies and are aware that an organisation's climate can promote or poison creativity and innovation [31]. However, having an organizational climate that only rewards innovative ideas and behaviours is not enough [30]. Organizational climate should also support open communication and multi-level collaboration across functional teams; empower teams by getting support from company executives; encourage risk-taking, flatter organization structures, feedback, and intensive cooperation with stakeholders; and let stakeholders participate in the innovation process and its outcomes [21].

### MATERIAL AND METHODS

The present study was conducted in textile exporting firms of Pakistan. This research is quantitative, and a well-structured adapted questionnaire was designed to collect the primary data from the managerial level staff of textile exporting firms of Pakistan by using a nonprobability convenient sampling technique. Two hundred and fifty questionnaires were delivered to targeted respondents through email and gave them one month to fill the questionnaire and returned it to the researchers. After one month, 220 questionnaires were received, from which twenty questionnaires were found incomplete and excluded from the final sample. After this, 200 valid and complete responses were added for analysis. The respondents' response was judged on a five-point likert scale consisting of 1 for strongly disagree and 5 for strongly agree. The questionnaire items were already used and had strong reliabilities in the context of Pakistan and other countries. Sources of these items are mentioned in table 1. For data analysis Statistical Package for the Social Sciences (SPSS) have been used.

Table 1

MEASURES USED FROM EXISTING STUDIES				
Sr. no.	Construct	Items	Reference	Cronbach's $\alpha$
1	Transformational leadership	7	Berends et al. [7]	0.80
2	Ambidextrous leadership	6	Farr et al. [2]	0.90
3	Innovative climate	4	Jansen et al. [18]	0.87
4	Employee performance	7	O'Reilly et al. [16]	0.85

## RESULTS

### Descriptive analysis

A total number of 250 questionnaires were sent to the respondents through email. After one month, 220 questionnaires were received, of which 20 were found incomplete and excluded from the final sample. Therefore, the response of 200 respondents was entered into SPSS for analysis. To analyze the descriptive characteristics, the respondents' age, qualification, designation, and experience were discussed, which is presented in table 2.

Table 2

DESCRIPTIVE ANALYSIS		
Constructs	Items	Percentage
Age	Up to 25 years	15
	25–35 years	20
	36–46 years	35
	Above 46 years	30
Qualification	Graduation	36
	Masters	40
	Above Masters	24
Designation	Deputy Manager	22.5
	Manager	47.5
	General Manager	30
Experience	Up to 3 years	10
	3–6 years	25
	7–10 years	30
	Above ten years	35

### Multiple regression

Multiple linear regression was performed to check the relationship between transformational leadership, ambidextrous leadership and innovation climate on employee performance. After the analysis, the model was significant as ( $p < 0.01$ ), and the value of F-statistics is 57.92. The coefficient of determinants ( $R^2$ ) value is 0.518, which shows that 51.8% change in employee performance is due to these three independent variables (Transformational Leadership, Ambidextrous Leadership, Innovation Climate) rest of

the shift may be due to other variables which are not included in the model.

Furthermore, the results of multiple linear regression show that all three variables have a significant and positive impact on the dependent variable as  $p < 0.05$ . The standardized coefficient ( $\beta$ ) for each independent variable is transformational leadership (0.313), ambidextrous leadership (0.293) and innovation climate (0.420) show that all independent variables have a positive and significant impact on employee performance.

Table 3

REGRESSION RESULTS	
Model variable	Standardized $\beta$
Transformational Leadership	0.313
Ambidextrous Leadership	0.293
Innovative Climate	0.420
F	57.92
R <sup>2</sup>	0.518
Adjusted R <sup>2</sup>	0.515

### Mediation analysis

Mediation analysis has been performed to check the mediation effect of innovation climate between independent variables (transformational leadership and ambidextrous leadership) and the dependent variable (employee performance). Analysis shows that total effect (0.472) with direct effect (0.249) and indirect effect is (0.223) along with ( $p < 0.05$ ). Between lower confidence level and upper confidence level, there is no zero, so it confirms that innovation climate mediates the relationship between transformational leadership and employee performance. Sobel's test value ( $z=4.85$ ) also proves the mediation. Similar results also present that innovation climate also mediates the relationship of ambidextrous leadership and employee performance, and Sobel's test also confirms mediation ( $z=5.27$ ).

## DISCUSSION AND CONCLUSION

The primary purpose of the current study is to find the meaningful relationship of transformational leadership and ambidextrous leadership of an organization's CEO on the overall improvement in the performance of employees. Additionally, the mediating role of innovation climate within the organization is also under consideration. The study's findings revealed that all the hypotheses found positive and significant to which shows the relationship of variables.

First, under sight study shows the relationship between transformational leadership and employee performance in Pakistani textile exporting firms. After analyzing it was found that the impact of transformational leadership on the employee is positive and significant. This is also supported by the results of a previous study conducted by Năstase et al. [32]. These results explain that if the top leadership has the vision to transform their policies according to the latest techniques and include the subordinates in decision-making, it will boost the employees' morale. As a result, they will work with more interest, and the performance of the employees will increase, mainly when the organisation exports its products at the international level. So, the leader should be transformed in their leadership and decisions.

Second, this study aims to find the relationship between ambidextrous leadership and employee performance in the textile exporting sector of Pakistan. Results of the study express that ambidextrous leadership has a significant and positive impact on the performance of employees. Similar findings were also presented by Hamel [25], Drejer [33], Mohsin et al. [34] previously in their study. These results prove that a leader should have ambidextrous abilities to lead its employees because a leader should have more talent and more sense of taking tough decisions compared to its employees. If a leader has less ambidextrous in his judgments and policymaking, it will discourage its employees, which will cause to decline in the performance of the employees. An ambidextrous leader always leads from the front to his employees and gets maximum results using leadership abilities. So, results prove that leaders should

Table 4

MEDIATING EFFECT					
Transformational. Leadership → Innovative Climate → EP	Effect	L.C.L	U.C.L	S.E	P
Total effect	0.472	0.235	0.570	0.051	0.000
Direct effect	0.249	0.231	0.476	0.040	0.000
Indirect effect	0.223	0.250	0.380	0.043	-
Sobel's Test Z=4.85					
Ambidextrous Leadership → Innovative Climate → EP	Effect	L.C.L	U.C.L	S.E	P
Total effect	0.454	0.346	0.487	0.073	0.000
Direct effect	0.249	0.365	0.543	0.058	0.000
Indirect effect	0.205	0.475	0.495	0.067	-
Sobel's Test Z=5.27					



be more ambidextrous within the organization. This will cause to enhance the performance of employees. Third, this study examines the mediating role of innovation climate between the relationship of transformational leadership and employee performance in the textile exporting firms of Pakistan. Results show that innovation climate partially mediates the relationship between transformational leadership and employee's performance. Similar results were also presented by Gebert et al. [15], Horth and Buchner [24] and Naseem [35] earlier in their studies. Innovation climate is a more critical element when an organization is exporting its products to other countries. If there is a lack of innovation climate with the organization, that organization cannot survive a long in the international market. So, a CEO should have transformational leadership qualities. He should provide an innovative climate in the organization so that employees can work at their total capacity, which will enhance their performance in the organization [36, 37].

Fourth, this study aims to analyze the mediating role of innovation climate between the relationship of ambidextrous leadership and employee performance. Outcomes of this study show that innovation climate partially mediates the relationship between ambidextrous leadership and employee performance. These results are supported by the findings of Giesen et al. [12] and Loewe and Chen [13]. Previously they also presented similar results in their studies. Along with the ambidextrous leadership of the CEO, it is more critical to provide an innovative

climate to employees within the organization to enhance their performance of employees. A creative environment in the organization is considered a key element in an exporting firm.

## LIMITATIONS AND FUTURE RESEARCH

The present study contributes many valuable additions to the existing literature. However, besides its contributions, some limitations of the study are significant to discuss here. First, the sample size of the study is minimal, and this might not be presented the whole picture of the textile exporting sector of Pakistan. Secondly, this is an empirical study, and the authors are scholars, so it was impossible to travel for them all over the country. Finally, they delivered questionnaires to respondents through email, which will affect the intention of respondents to fill questionnaires appropriately.

Despite the contributions of this study to the existing literature, there are many aspects yet to discuss for future studies so that the deficiencies in the literature can be covered. For example, future researchers can be enhancing the sample size, and it can be applied to other sectors irrespective of the textile sector. Furthermore, a moderating variable can also be used to measure the relationship between leadership and employee performance.

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# Comparative analysis of 100% cotton Siro and single yarns

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## ABSTRACT – REZUMAT

### Comparative analysis of 100% cotton Siro and single yarns

*The aim of this work is to carry out the comparative study to analyse the properties of Siro and single yarn with different linear densities. For this purpose Siro yarn and single yarn with the same linear densities were produced from cotton. Tensile strength and related properties such as evenness, imperfections and hairiness have very important role in weaving. In this comparative study Siro and single yarn with linear densities of 10 Nec, 14 Nec and 18 Nec were manufactured, tested and analysed. Two rovings were used for Siro and one roving was used for single yarn. Comparative study revealed that Siro yarn exhibit better tensile strength and related properties.*

**Keywords:** Siro and single yarn, tensile strength, evenness, hairiness and imperfections

### Analiza comparativă a firelor 100% bumbac Siro și a firelor simple

*Scopul acestei lucrări este de a efectua un studiu comparativ pentru a analiza proprietățile firului Siro și ale firului simplu cu densități liniare diferite. În acest scop, au fost produse fire Siro și fire simple din bumbac cu aceleași densități liniare. Rezistența la tracțiune și proprietățile asociate, cum ar fi uniformitatea, imperfecțiunile și pilozitatea, au un rol foarte important în timpul țeserii. În acest studiu comparativ, firul Siro și firul simplu cu densități liniare de 10 Nec, 14 Nec și 18 Nec au fost fabricate, testate și analizate. Două semitorturi au fost folosite pentru Siro și un semitort a fost folosit pentru firul simplu. Studiul comparativ a arătat că firele Siro prezintă rezistență la tracțiune și proprietăți asociate superioare.*

**Cuvinte-cheie:** fir Siro și fir simplu, rezistența la tracțiune, uniformitate, pilozitate și imperfecțiuni

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## INTRODUCTION

Ring spinning is the popular and oldest of present day spinning processes, it can be attributed mainly to flexibility, universal applicability and yarn quality. Ring spinning is the leading technique for producing quality yarn in spite of its limitations. Various efforts have been made to overcome limitation of ring spinning. Limitation for ring spinning are spinning triangle, balloon tension, traveller speed and spindle speed which lead to hairy structure and lower production of yarn [1–3]. Spinners are focused to overcome the limitations to get yarn with improved properties. In 1975 CSIRO developed a technology for woollen Siro spun yarn, later the development was commercialized in 1980 by group consist of the Melbourne engineering company Warren, Brown and Staff, IWS and CSIRO [4, 5]. In Siro spinning, two parallel rovings are drafted in the same drafting zone on ring machine, after they emerge from the nip of front top and bottom rollers, they come together to form a yarn by twisting [6]. Siro yarn has better physical and other mechanical properties such as high evenness, low CV%, less Imperfection and low hairiness, high tenacity, more extension, higher work of rupture and more breaking strength as compared to single ring spun yarn. Researchers are focused on Siro yarn properties and structure with properties of others

yarns e.g., solo yarn, Siro solo, vortex yarn, OE yarn and/or ring spun yarn [7, 8]. The basic aim of the present work is to compare Siro yarn and single ring spun yarn with range of same linear densities

## MATERIAL AND METHOD

The characteristics of the cotton fibres used for this study are shown in table 1. For opening cleaning and mixing of the cotton raw materials Rieter blow room was used. The Reiter blow room includes Mixing bale opener, Uniclean B11, Mixing opener followed by Uniflex for inter laminar flow for chute feed system. After opening cleaning and mixing the fibres, sliver was produced on card C51 with the linear density of 4 ktex. For more mixing and parallelization of sliver the carded sliver was processed on Rieter draw frame RSBD 35. 8 carded sliver were processed on draw frame to get 4 ktex slivers. For comparative analysis all the rovings of different densities were kept same. Other technological parameters were kept unchanged. After drawing the sliver 0.93 hanks roving is formed on simplex FA 415. Siro and single yarn samples were produced with linear densities 10 Nec, 14 Nec and 18 Nec on ring frame EJM 168 by keeping same Twist multiplier (TM). On ring frame EJM 168 two eyed roving guides were used for Siro yarn samples and one eyed roving guides for single

yarn so that the roving can be guided to the drafting zone properly. Two rovings were fed to drafting zone for Siro yarn and one roving for single yarn with 0.93 hanks. Ring Frame Adjustments are shown in table 2. Uster tester-4 was used to determine evenness, thick thin places, mass variations and imperfection. Yarn strength and elongation were tested on Uster Tensorepid-4.

Table 1

COTTON FIBRE PROPERTIES	
Cotton type	Pakistani (MNH 83)
50% span length (inch)	0.6032
2.5% span length (inch)	1.0756
Fibre fineness (MIC)	4.2
Fibre strength – Pressley value (cN/tex)	27.3

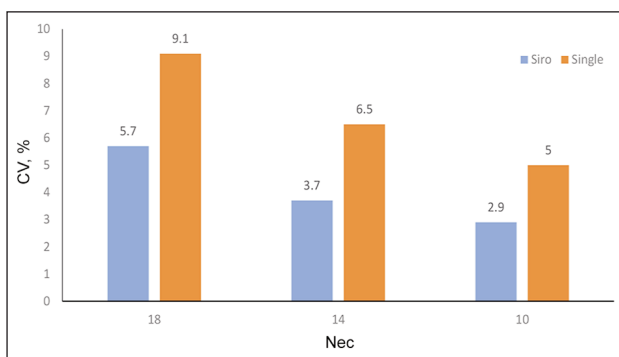


Fig. 1. Comparisons of yarn CV%

which are separated by an air gap and the yarn acts as dielectric [7]. The Siro yarn with linear density of 18 Nec, 14 Nec and 10 Nec exhibits improved CV%. The mean values of C.V of single yarns (18, 14 and 10 counts) are 9.1%, 6.5% and 5%, while the mean C.V% values of Siro yarns were 5.7%, 3.7% and 2.9% shown in figure 1. The C.V% values shows that, the Siro yarns had lower C.V% than the single yarn by 3.89 %, 6.80% and 15.2 % with yarn linear density of 18, 14 and 10 Nec respectively. Yarn irregularity and coefficient of variation of irregularity in Siro yarn have improved due to the structure. Siro yarn structure has more consistent and smoother as compared to ring single yarn [9–11].

Table 2

RING FRAME ADJUSTMENTS						
Parameters	Siro			Single		
	10 Nec	14 Nec	18 Nec	10 Nec	14 Nec	18 Nec
Hank roving	0.465 Nec			0.93 Nec		
Break draft	1.45	1.45	1.45	1.45	1.45	1.45
Total draft	21.50	30.10	38.70	10.752	15.053	19.354
TM	4.2	4.2	4.2	4.2	4.2	4.2
TPI	13.28	15.72	17.80	13.28	15.72	17.80

Table 3

YARN PROPERTIES						
Parameters	Siro			Single		
	10 Nec	14 Nec	18 Nec	10 Nec	14 Nec	18 Nec
Evenness CV (%)	2.9	3.7	5.7	5	6.5	9.1
Thick places (+50 %)	38	144	272	40	212	310
Thin places (-40 %)	26	130	278	28	308	494
Hairiness (%)	8.95	7.58	6.76	10.72	7.84	7.17
Elongation (%)	5.3	4.25	3.75	5.18	4.19	3.7
Tenacity (cN/tex)	1978	1751	1671	1681	1632	1606

## RESULT AND DISCUSSION

### Comparison of irregularities in yarns

Yarn irregularity is the variation in weight per unit length of the yarn or standard deviation of irregularity CV %. UT-4 was used for the testing of CV % of a yarn. UT-4 is based on capacitive sensor which measures the capacitance between two separated conductive plates. Yarn is passed between two conductive plates

**Comparison of IPI**  
IPI stands for imperfection index which shows the thick places, thin places and neps. Occurrences of yarn mass 50% more than the yarn mean value per kilo meter shows thick places. Similarly occurrences of 50% thinner places in yarn are called thin places. Entanglement of fibres having mass 200% to the yarn mean mass per kilo meter is called nep. The mean +50 thick places values of single yarns are 312, 212 and 40 while the mean +50% thick places values of Siro yarns are 272, 144 and 38 respectively. The +50% thick places values shows that the Siro yarns had less thick places than the single yarn by 22.9%, 32.1% and 5% with the same linear density of 18, 14 and 10 Nec respectively (figure 2).

The mean (-40%) thin places values of single yarns are 494, 308 and 28 while the mean (-40%) thin places values of Siro yarns are 278, 130 and 26 respectively. The (-40%) thin places values showing that, the Siro yarns had less thin places than the single yarns by 44%, 57.8% and 7.15% with the same linear density of 18, 14 and 10 Nec respectively (figure 3). However, the overall IPI improved in Siro yarn as compare to single yarns because of fibres are almost completely bound in the body that produces smoother surface and as a result yarn fault were reduced [9–11].

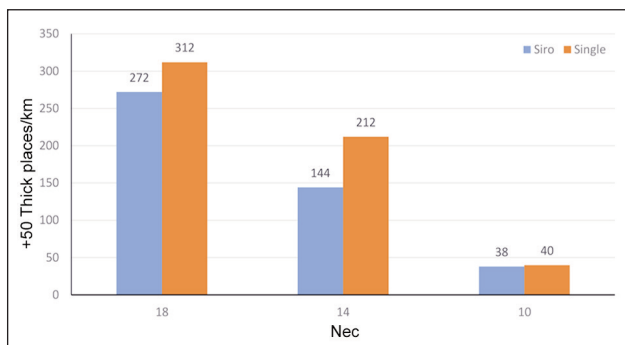


Fig. 2. Comparisons of +50 Thick places/km

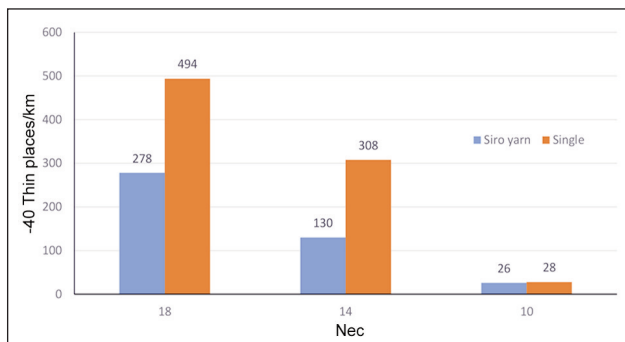


Fig. 3. Comparisons of (-40%) Thin places/km

### Comparison of yarn hairiness

In UT-4, hairiness is the ratio of the total length of protruding fibres (in centimetres) per centimetre of yarn [13, 14]. The hairiness of Siro yarns and single yarns of all linear densities are compared which is shown in figure 4. The mean hairiness values of single yarns are 7.17, 7.84 and 10.72 while the mean hairiness values of Siro yarns are 6.768, 7.58 and 8.95. The hairiness means values showing that, the Siro yarns had less hairiness than the single yarn by 5.72%, 3.42% and 6.6%, with yarn linear density of 18, 14 and 10 Nec respectively. Lower hairiness is indicating about the more consolidated structure. It is showing that fibres are highly integrated in the body of Siro yarn as compare to ring single yarn [11, 12].

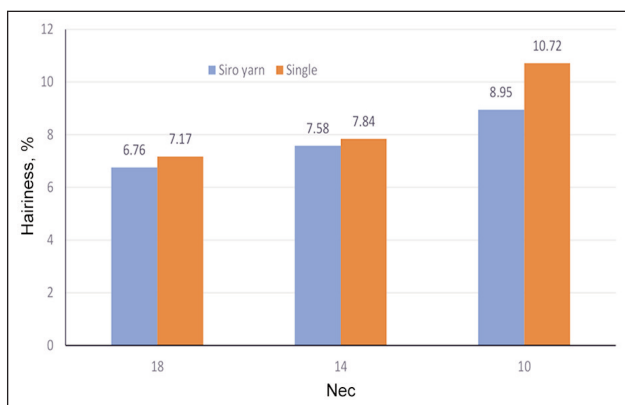


Fig. 4. Comparisons of yarn hairiness

### Comparison of tensile properties of yarn

UTR-4 is used to determine the tensile properties of yarn such as breaking force, elongation, and toughness properties of the yarn. Siro and single ring spun yarns with the same linear density of 18, 14 and 10 Nec were tested. The mean elongation % values of single yarns are 3.7%, 4.19% and 5.18% while the mean elongation % values of Siro yarns are 3.75%, 4.25% and 5.3% respectively. The values showing that, the Siro yarns had greater elongation than the single yarn by 1.34%, 1.42% and 2.23% (figure 5). The elongation % of Siro yarns ascribed to the fact that in the core fibres of Siro yarn did not straighten due to two drafted strands special twisting (self-twisting) with each other. In this way, due to self-twisting of strand to each other, the fibre may get crimp and thus tensile force applied on Siro yarn initially open the crimp. Therefore fibres in Siro yarn exhibits elongation greater than single ring spun yarns.

The mean CLSP values of single yarns are 1606 cN/tex, 1632 cN/tex and 1681 cN/tex while the mean CLSP values of Siro yarns are 1978 cN/tex, 1751 cN/tex and 1606 cN/tex respectively (figure 6). The tenacity values shows that, the Siro yarns were considerably stronger than the single yarn by 3.89%, 6.80% and 15.2% with yarn linear density of 18, 14 and 10 Ne respectively. The tenacity of Siro yarn is greater than single yarn due the particular yarn structure, in Siro yarn structure the fibres are firmly bound within the yarn structure. Two twisted strands drafted fibres caused some surface fibres to be trapped into

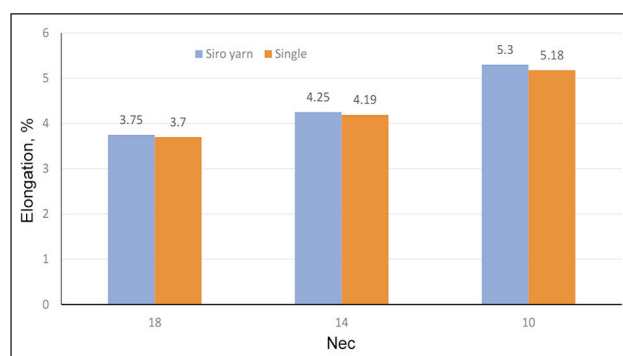


Fig. 5. Comparison of Elongation %

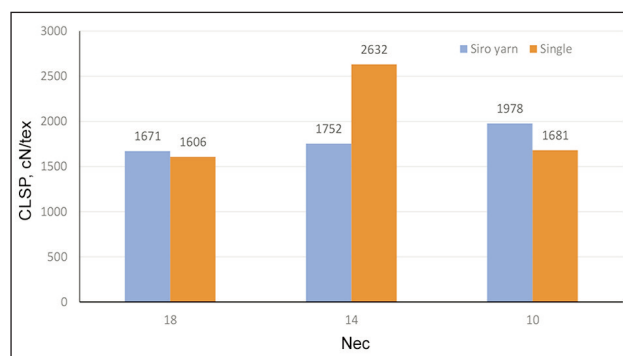


Fig. 6. Comparisons of yarn CLSPs

Siro yarn so as to increase the inter-fibre cohesion in the yarn which can withstand higher breaking force [11, 12].

## CONCLUSION

The different counts 18, 14 and 10 of Siro and single yarns were spun in order to analyse the mechanical and physical properties. Both types of yarns were manufactured by 100% cotton fibre. Both types of spun yarns were analysed by mechanical and physical

testing. Due to the special twisting and particular yarn structure of Siro Spinning system, Siro yarn had better yarn characteristics than single yarns such as tenacity, elongation, thick and thin places, C.V% and hairiness.

It was observed that the tenacity values of Siro yarns were significantly stronger than the single yarn and greater elongation than the single yarn. +50% thick places, the Siro yarns had less thick places than the single yarns.

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# The discourse of Kurdish traditional textiles

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## ABSTRACT – REZUMAT

### The discourse of Kurdish traditional textiles

*Verbal communication is not the only way by which people can interact; people communicate with each other through different signs, colours, cultural symbols and costumes. One of the ways that people can communicate through is clothes or textiles. The language of textiles and its covert discourse have not been studied profoundly. Each bit of textile has its specific meaning. Through the discourse of their clothes, people try to show their nationality, age, gender, social status, geographical belonging etc. Kurdish traditional clothes are believed to be culturally rich, since they are dressed by a large number of people in the past and present. This study is an attempt to examine the relationship between discourse and clothes. It tries to study the hidden discourse of Kurdish traditional textiles. The study seeks to answer several questions, including: What do the clothes say about the people who wear them? How different types of clothes show different forms of people's identity? How do clothes reveal the people's nationality, age, gender, geographical territory and social class? The principles of discourse analysis, more specifically Foucault's approach of material discourses, are used to investigate the collected data. The study uses a mixed approach of quantitative and qualitative methods. The data are collected in three ways: by analysing the photo albums, a survey and a site visit to Kurdish Textile Museum in Erbil. The study concludes that the pieces of textiles can be seen as linguistic elements in communications and Kurdish traditional clothes embraces specific cultural codes and symbols that can be used to reveal the discourses they embrace.*

**Keywords:** discourse analysis, language of textile, Kurdish culture

### Discursul textilelor tradiționale kurde

*Comunicarea verbală nu este singura modalitate prin care oamenii pot interacționa; oamenii comunică între ei prin diferite semne, culori, simboluri culturale și costume. Una dintre modalitățile prin care oamenii pot comunica este îmbrăcămintea sau materialele textile. Limbajul textilelor și discursul ascuns al acestora nu au fost studiate în profunzime. Fiecare bucată de material textil are semnificația sa specifică. Prin discursul îmbrăcămintei, oamenii încearcă să-și arate naționalitatea, vârsta, sexul, statutul social, apartenența geografică etc. Se crede că îmbrăcămintea tradițională kurdă este bogată din punct de vedere cultural, deoarece este purtată de un număr mare de oameni din trecut și din prezent. Acest studiu este o încercare de a examina relația dintre discurs și îmbrăcămintă. Se încearcă să se studieze discursul ascuns al costumelor tradiționale kurde. Studiul caută să răspundă la mai multe întrebări, printre care: Ce spune îmbrăcămintea despre persoanele care o poartă? Cum diferite tipuri de articole de îmbrăcămintă arată diferite forme de identitate a oamenilor? Cum dezvăluie îmbrăcămintea cetățenia, vârsta, sexul, teritoriul geografic și clasa socială a oamenilor? Principiile analizei discursului, mai precis abordarea lui Foucault privind discursul despre materiale, sunt folosite pentru a investiga datele colectate. Studiul folosește o abordare mixtă de metode cantitative și calitative. Datele sunt colectate în trei moduri: prin analiza albumelor foto, un sondaj și o vizită la Muzeul Textil Kurd din Erbil. Studiul concluzionează că piesele de îmbrăcămintă pot fi văzute ca elemente lingvistice în comunicare, iar îmbrăcămintea tradițională kurdă prezintă coduri și simboluri culturale specifice, care pot fi folosite pentru a dezvălui discursurile pe care le exprimă.*

**Cuvinte-cheie:** analiza discursului, limbajul materialului textil, cultura kurdă

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## INTRODUCTION

One way people can display themselves to their surroundings is through the language of the textiles. This kind of language is an interesting way of communication that can be used to convey various messages. Each piece of Cloth, fibre or textile has its special discourse. This discourse is universal and found in in all modern and traditional clothes all over the world. People send messages by wearing different types of clothes in different occasions and rituals, such as, religious rituals, wedding nights, graduation ceremonies, etc. [1]. Kurdish people also dress spe-

cial traditional clothes in exceptional occasions nowadays, though some of them wear these kinds of dresses in their everyday life.

Clothing communicates various meanings that sometimes it is difficult to be deciphered. Alison Lurie, an American professor, points out that understanding the meaning of clothes is not easy, since they consist of a complex system of secret codes that have a crucial role to communicate the personal and collective discourses. She believes that communicating with the clothes' codes comes before language. Long before communicating through verbal codes, people

could reveal their gender, age, ethnicity, occupation, personality and social class through what they were dressing [2].

The concept of traditional textiles which is central to this study, need to be explained, since this concept is not static. It changes its discourse over time and place. What Kurds living abroad (diaspora) wear as traditional Kurdish clothes is a cloth that is dressed daily by Kurds in Iraqi Kurdistan region or what Kurds wear as a national symbol in Nawroz (the new Kurdish year and festival) is the same cloth that dressed by peasants in their daily life. Baizerman et al. [3] discuss the concept of traditional clothes in western civilization. They believe that dress outside the boundaries of west, in Asia and Africa, for example, has not changed very much and that's why it can be regarded as 'traditional'. The western dress is originated from western traditional clothes but it has been changed. Nowadays, the western dress is a universal dress; it is dressed by people all over the world as the modern dress not traditional. Many Kurds now dress the suits, pants, shoes and the other western clothes, but they do not regard them as western traditional clothes.

Since Kurds are the largest nation without having their own state or country, their culture, materials and language, are influenced by the host countries and their dress is also influenced by the local clothes of these countries. Furthermore, Kurdish people still have numerous garments that differ from one Geographical area to the other, in a way that it is possible to differentiate between them and the ethnic groups, or even, to recognize the area in which the Kurds live by having a closer look at their clothes. This is one of the variables that this study is trying to investigate. Kurds live in Kurdistan which lies around the mountain of Zagros that is currently divided between the borders of Turkey, Iraq, Iran, and Syria [3].

## LITERATURE REVIEW

Many studies have been conducted to examine many aspects of textile and clothing. In this section some of the relevant studies are consulted. Starting from ancient history, in the 7th to 5th BC, when different ethnics, such as, Medes, Persian and Mitanni were living in the Middle East, their clothes were different. One can differentiate between Medes and Persians by the clothes they dressed, [4].

Nowadays, textiles can be regarded as a marker of group differentiation. The marker can be seen as national, ethnic, geographical, gender or social identity. Nash [5] regards this marker as a secondary group identity that allows members of the group to know each other and have a sense of belonging. "Difference in dress, from whole costumes to single items of apparel, serves as surface markers of group differences" [5].

Textile design and materials give meanings to the textiles, but they are not the only elements of clothing language. Colour is another sign in the language of

clothes that can convey different messages to the eye of the viewers. People from different backgrounds and groups tend to wear different coloured clothes. Urban clothes are every so often made in colours that echo the shades of cement, stone, smoke, grey skies and wet asphalts, which are grey, black, white and darker, while rural people and villagers tend to wear soft and fuzzy clothes which are made from wool, tweed and cotton that echo the roughness of pasture and bark and leaf, [2].

Discourse analysis is a multi-disciplinary approach. Its principles can be used to analyse different types of texts in different fields of humanities; it is a well-established method in the humanities. There are different methods and ways by which researchers can do discourse analysis, some of them are qualitative and others quantitative. It is difficult "to achieve an accurate identification of all these different schools or fields which are employed or tackled while doing discourse analysis" [6]. One of the definitions of discourse is the study of the abstract concepts within the texts. One of the leading figures in the field of discourse analysis is Michel Foucault. He had his own understanding to discourse meaning and discourse analysis. He argues that "discourses", i.e., historical knowledge formations and narratives, emerge according to a vast and complex set of discursive and institutional relationships that manifest themselves in language [7]. The analyses in this study mainly depend on his views on discourse.

Discourse analysis is a suitable method to study the covert discourse of textiles, since clothes have coded symbols and these codes need to be analysed in the cognition of the human brain. This coded sensorium interacts with nonverbal messages that are continuously sent from these textiles that aids human interaction in space and time. The signs of the clothes or textile include different visual symbols, such as, images and colours that interact with abstract sensorium, such as taste, smell, sound and feel, [5]. "Discourse thus gives sense to the material world through the way it differentiates, names, labels, classifies and categorizes, and thereby produces, recognizable objects" [8].

In Foucault view of material discourse analysis, the textiles are abstractions that are changed into reality through the process of attributing particular meaning to them [9]. So, Foucault [7] believes that discourses "systematically form the objects of which they speak". The discourses do not just describe the world; they create it through bringing the phenomena into being and attaching meaning to them. Foucault's theory and understanding of discourse focuses on language materiality at all its scopes [10].

In the study of discourse analysis and materiality, a number of discourse analysts have benefited from the works of Foucault. They have acknowledged that it is important to incorporate discourse and materiality to see how the hidden power of the messages is shared between the participants of a communicative event. They contributed to the debate other relationship between discourse and materials [11–13]. The



emphasis of Foucault's discourse is not only understood in the textuality and knowledge, but in the policy of social and political institutions, in forms of everyday practices [14].

Foucault believes that the relationship between discourses and materials is bilateral, which means that discourse can shape materials and materials can shape discourse. He points out that the relationship is also related to power. "Nothing is more material, physical, and corporeal than the exercise of power" [15]. His focus is also on how epistemologically the discursive and non-discursive forms are interwoven. He believes that "the discursive effects of the material and the material effects of the discursive" are bilateral, [14]. Discourse analysts tried to adopt Foucault's theory on material reading to analyse discursive and physical processes and to look at the way they are constitutive [13, 16], not only to discuss which one affects the other. Nonetheless this kind of understanding helps the scholars to examine power relations [14, 16].

One of the obvious messages in the discourse of textile is the sense of belonging; it is an identity that people try to display through wearing traditional clothes. Humans are social beings and they want to show their belongings to their families, community, country or nation. Gordon [1] points out clothes can function as the national and political identity. He states "National flags, for example, become literal representatives of the national "body" and hold enormous power. In the United States people literally pledge allegiance to a flag. Others flags represent contested identity. "Cloth is central in our lives as social beings. It bonds us to our families, even those who have passed on." Different nations, countries and groups of people have their special dresses that make them different from others [17].

Obviously, national or ethnic dresses have special referents and ethnic groups use them for different purposes to send different messages. In addition to their national purpose, they may have other purposes too, such as, religious, social or occupational. So the national or traditional dress is not static, it can change its messages depending on the context, time and occasion [5]. If we talk about Kurdish traditional dresses, one can see that they can be dressed in different occasions in different periods of time. In the past, Kurdish traditional dress was dressed everywhere by every people, but nowadays only few people dress them in their daily life; the majority of Kurds dress the traditional clothes only for special occasions and festivals like Nawroz and other national days. That's why, analysing the discourse of ethnic clothes is somehow problematic, and they are "among the most complicated, volatile and emotionally charged words and ideas in the lexicon of social science" [5].

The recent studies on nationalism and ethnicity conducted by historians, politicians, and social scientists in academia have anticipated that ethnicity and nationality feelings would fade away by the powers of

internationalization, globalization and ethnic assimilation in the postmodern era. Yet, in reality ethnicity and national identity has been rising over time in most parts of the world contrary to the anticipation. One can see that nowadays these issues have become central in the debates, conferences and academic discourses all over the world, and politicians still manipulate these sentiments in their election campaigns [18–20]. Dressing and redesigning the traditional ethnic and national dresses by the new generation in the present time is another proof that these issues are not fading away.

The traditional textiles are not only dressed by local people, but also by those who live outside their communities, nations and countries. Nowadays the term of transnationalism is used widely in academic discourse. It refers to the national, ethnic, social, cultural, political and economic bonds that people have beyond the boundaries of nation-state [21, 22]. For Kurds transnationalism can include two dimensions. On the one hand, since Kurds do not have a nation-state and they live in their host countries, such as Turkey, Iran, Iraq and Syria, transnationalism feeling is expressed through their textile that can gather all of them together. On the other hand, diaspora Kurds who are scattered outside Middle Eastern countries in Europe or America, they wear the same clothes in special occasions to preserve their national identity. These transnational activities that take place across national boundaries may be conducted by powerful representatives of national governments or by ordinary immigrants living abroad [23].

Banal Nationalism is another area relevant to discourse analysis and textile analysis or material analysis. Billig [24] points out that banal nationalism refers to those signs that build an image of national identity among a group of people. It includes, for example, raising national flag, which is a piece of textile, in national ceremonies or putting national symbols on currency. These signs of banal nationalism are regarded as ideological hints which are interwoven to the discourse to be seen by people and to become part of everyday life of citizens. These signs are very effective because they are repeated systematically.

The approach which has been used in this study is suitable for analysing national, ethnic and traditional clothes. Foucault's theory and underrating of discourses helps in creating a critical framework for the role of materials in shaping the national identity, "embedded in a discourse-historical approach, currently imagined as 'body-politics' in many national publics" [25, 26].

Discussing the relationship between gender and dress, in all cultures, the difference in male and female dresses is obvious. Gender and dress are interlinked. Issues related to gender involve showiness, cover-up and disclosure in clothes. Issues that often related to ethnic group norms and traditions; how the societies see the suitable clothes for men and women within their culture considerations. The

focus is more on women's clothes rather than men in these cultural norms and traditions [27].

Belonging to a geographical area is another sense that people try to show through their clothes. People from different geographical places dress different types of clothes. One can recognize the place of living of people through their dresses. Gordon [1] believes that one function of clothes is to act as a tangible expression of people's extensive and diverse geographical and political territory.

Social status which is the honour or prestige that attached to someone in a certain social position or rank can be shown through textile. Throughout history high ranked and rich people wear different clothes. They want to separate themselves from lower and poor people. Their dresses send various messages to their surroundings to say that their political, economic or social status is higher than the others. Gordon [1] provides examples for the cost of higher status people's dresses. For example, for a Baroque tapestry a number of people need to work for around a year, or to complete a very fine Kashmir around thirty men have to work for around nine months.

Nowadays, Asian and African societies consider the types of clothing people dress to represent their social class. In South Africa and Lesotho, for example Sotho men and women dress brightly colourful blankets with decorative configuration in important occasions, or, some type of clothes, such as Seana Marena "King's blanket" show fertility and richness [28]. The relation between clothing and social class has a long history. It was usual in the history of mankind that the clothes of kings and monarchs were different from the clothes of ordinary people. For thousands of decades, some kingdoms passed orders known as 'sumptuary laws' to prohibit the dressing of certain clothes by certain social classes. In ancient Egypt merely those from high class and position could wear sandals; the Romans and Greeks organized the kind, colour, and amount of the garments dressed [2].

Kurdish textiles have some characteristics of Middle Eastern textiles, since Kurds are regarded as original people of the area who mainly live in four countries in the region: Turkey, Iran, Iraq and Syria, though there are Kurdish minorities living in other countries. Historically, Kurdistan, the land of Kurds, was part of the two large empires, Persian and Ottoman. The people of Kurdistan have a long tradition of cultural symbols; one of them is the unique clothes they wear. Though Kurdish people survived many invasions, one way to preserve their cultural inheritance is through wearing their own traditional dresses. The native Kurds who live in different countries in the Middle East are regarded as indigenous people, but those who live in the west are regarded as diaspora migrants [29].

## METHODOLOGY

Foucault's approach to discourse of materials is used as the theoretical base for this study. According to

this approach the material discourses are abstractions that are changed into reality through acquiring meaning. The study focuses on the textiles discourses in the areas of nationality, age, gender, geographical territory and social class. The data are collected in three ways, through:

- Site visit to the Kurdish Textile Museum: it is a private non-profit museum established by Mr. Lolan Mustafa in 2004 in the house of Mr. Hashim Dabagh, reconstructed in the 1930s and located at the historical site of the Erbil Citadel.
- A survey: it consists of 22 questions. The questions are divided into five parts, including questions on nationality, age, gender, geography and social status. One hundred responses are received and analysed.
- Analysing the content of photo albums of two different Kurdish online sites Facebook page: Kurdish Clothing, and Kurdish cloths [www.pinterest.com](http://www.pinterest.com).

This study is not expected to examine all aspects of Kurdish traditional textiles. It restricts to the study of discourse with these materials. It targeted the Central Kurmanji (Sorani Kurds) Culture and tradition that's why the three sources of data were from Erbil, since the city is the capital of the Iraqi Kurdistan Region and recently it has got a political and diplomatic state internationally. One hundred people participated in this study by email. The participants were members of the academic staff of Erbil polytechnic university, who were native speakers of Kurdish. They have been randomly chosen. The study uses a mixed approach of qualitative and quantitative approaches. The study is not a historical study of ancient Kurdish textile, it focuses on the messages these materials convey. It also does not study the types and classifications of the Kurdish traditional clothes; nevertheless, it is an attempt to reveal different discourses found in different types of clothes.

## ANALYSIS OF RESULTS

### Results of analysing the site visit

As stated in the methodology section, a site visit was done by the researcher to see thousands of textile pieces. Site visits are regarded as fundamental for this kind of study to collect data, since the researchers can use several senses to examine the data, not only the visual sense. He can feel, taste and touch the textiles, examine their weights, read the captions written under the pieces, and see the real colour of the materials. The following results were obtained from the visit:

- One can feel the meaning of the messages the textiles sends and the uniqueness of Kurdish clothes and its special characteristics that vary in colour, design and material. The traditional Kurdish clothes are made differently depending on the geographical region. Thus the discourses of these clothes are apparent. For example, the clothes worn by Hawramis are different from that worn by Hawleris.
- The textiles used by men are different from those used by women. Depending on the geographical

region, they vary in shape, design and colour. Generally, the men dress short tight jackets over lined shirts and a clothing belt (sash) that surrounds the waist. They wear wide baggy pants (shalwar) that are comfortable for all seasons.

- Women's textile is different from men's dress. The differences again depend on the region. Unlike men's dress, they are mostly colourful. They have several layers. They wear baggy trousers, just like men, but the material and the design are different. They also wear a long shirt which is called "Kras" in Kurdish, a long transparent dress with long sleeves. On the top of the Kras, women wear a short button less covering called "Sukhma" and in winter time they wear a long jacket called "Kewa" which is sometimes made of velvet tissues. A black Haba is worn by older women in Iraqi Kurdistan region, which is a sign for age. In general, Kurdish women traditional clothes are more colourful and decorated.
- Kurdish older generation men put a kind of hat or Kufiya (jamadani or jamana) on their tops, often covering their heads as a regular turban. The shape of the turban changes depending on the geographical region, generation and social status. Regarding the colour, for example, Barzani Kurds wear a red turban, while the men from other areas of Erbil wear a black turban. Women older generation put on a traditional hat on their heads, but some of the younger generation put on a kind of scarf and hijab which are not regarded as Kurdish clothes; they are more Arabic and Islamic.
- Looking for the clothing discourse relating to geographical locations, one can find many examples of different types of clothes used by different people from different cities in Kurdistan, for example, the Duhoki men bottom pants (Sharwal) is much wider from that of Hawleris.
- Concerning the social status discourse displayed through clothes. The richer people wear more

expensive clothes than the poor people, for example, Kurdish richer men wear a kind of expensive suit (Rank u chogha) which is hand made in goats' hair.

### Results of the analysing the survey

For analysing the responses to the 22 questions of the survey, first the questions are classified into five groups according to the areas identifies in the methodology section: nationality, age, gender, geographical territory and social class, and the numbers are converted to percentage. Some of the questions are applicable to more than one area; therefore, they are repeated in more than one table. Then a table for each group is drawn.

For nationality: ethnicity and nationality are clear codes that can be detected in the discourse of textiles and clothing. Table 1 shows the results of the survey with regard to nationality.

By analysing the results of table 1, it's evident that textiles worn by people can convey the nationality of the wearer. The majority of people, around 55%, believe that they can identify the nationality of men and women through their clothes. Therefore, Kurds try to wear their traditional clothes.

Table 2 analyses the date by age: Kurdish grown-ups wear different textiles from the fresh people and children. The signs and codes found in the Kurdish traditional clothes signify the age of the wearer.

Analysing table 2, one can point out that age is an important factor in the discourse of Kurdish traditional textiles, especially the differences between the children and adults' clothes colour, and older versus younger generations clothes. The participants believe, 87%, that children wear more colourful clothes compared by adults who wear more colourless clothes. The majority of the participants, 80%, also believe most of the older generation wears Kurdish traditional clothes, compared to the younger generation who wear less, 35%, traditional clothes. Regarding knowing the age of grownups, men and women, the

Table 1

THE DISCOURSES OF NATIONALITY IN KURDISH TRADITIONAL CLOTHES				
No.	Questions	Yes	No	Maybe
1	Do you identify the nationality of a man through his clothes?	56%	13%	33%
2	Do you identify the nationality of a woman through her clothes?	54%	11%	35%

Table 2

THE DISCOURSES OF AGE IN KURDISH TRADITIONAL CLOTHES				
No.	Questions	Yes	No	Maybe
1	Do you know the age of a man by his clothes?	23%	31%	46%
2	Do you know the age of a woman by her clothes?	25%	27%	48%
3	Do Children wear colourful dresses?	87%	4%	9%
4	Do Children wear colourless dresses?	12%	60%	28%
5	Do older generations wear Kurdish traditional clothes?	80%	2%	18%
6	Do younger generations wear Kurdish traditional clothes?	35%	20%	45%

Table 3

THE DISCOURSES OF GENDER IN KURDISH TRADITIONAL CLOTHES				
No.	Questions	Yes	No	Maybe
1	Do Kurdish women dress colourful clothes?	78%	3%	19%
2	Do Kurdish men dress colourless clothes?	33%	25%	42%
3	Does the Kurdish older male generation wear Kurdish traditional dress?	82%	6%	12%
4	Does the Kurdish older female generation wear Kurdish traditional dress?	82%	4%	14%

participants are not sure whether they can know that through the clothes. A lot of them, 46% for men and 48% for women, said maybe which means they are not sure. Concerning the question of whether children wear colourless clothes or not, only few of the answers 12% were positive, 60% said no and 28% said maybe.

This means that the elderly may find pride in their traditional textiles; they have not been affected by the modern trend of preferring western style in clothing. The effect of the host country style and westernization on the younger generation is more prevalent. Now and again young people may choose to integrate to foreign values by taking on Western dress codes.

The analysis by gender: the language of gender is observable in Kurdish traditional textiles. The discourses conveyed by these materials enable people to distinguish men from women easily. Table 3 demonstrates this variable.

Table 3 shows that the design, style and colour of clothes of men are different from that of women. The participants believe that Kurdish women, 78 %, tend to wear more colourful clothes compared to men who tend to wear darker clothes. The participants' answers on whether Kurdish men dress colourless clothes were not clear, 33% said yes, 25% said no, and 42% said maybe, which means they were not sure. The results of the above table tell that most of the Kurdish older generation 82% wears Kurdish traditional clothes. The same is true for the older female generation. The design and style of women's clothes are more complicated than that of men. Women tend to put on accessories and jewelleryes.

The analysis by geographical region: people from different regions wear different textiles and clothes. The discourses of Kurdish traditional clothing can reveal

the geographical identity of people. Table 4 shows the differences in the language of clothing with regard to the place where people live.

Table 4 illustrates that the geographical place of people is not easy to be identified through their dresses. The answers of the participants are not very direct. The proportion of 46 percent say that they can distinguish the place of living of people through their dresses, 42 percent say they are not sure (maybe) and 12 percent say they cannot make this distinction. Regarding the difference between the dress of people from mountains and those from plain areas, the majority of participants, 69 percent, believe that people from mountains wear different clothes from those living in plain areas. The portion of 55 percent can distinguish the dress of urban residents from countryside residents. The same is true for the differences between the clothes of city and village women.

The analysis by social status: social class codes and symbols are another clue that textile discourses can signify. The following table illustrates the way clothes tend to send messages on the social class of people. Table 5 shows that Kurdish traditional textiles language is a factor in identifying the social status of people. The portion of 56% of the participants are certain that they can distinguish the rich people from the poor through their clothes, but they are not sure whether they can distinguish educated people from uneducated ones through their clothes or not; 28% say they can do that, but 38% say they are not sure (maybe) and 34% say they cannot do that. This is true for distinguishing literate and illiterate people too, with few variations. Concerning the differences in the clothes of literate and illiterate people, the participants were not sure whether they can differentiate between them or not, 47% said maybe. In answering the question whether they can distinguish high

Table 4

THE DISCOURSES OF GEOGRAPHICAL REGION IN KURDISH TRADITIONAL CLOTHES				
No.	Questions	Yes	No	Maybe
1	Do you know the geographical place of a man by his clothes?	46%	12%	42%
2	Do you know the geographical place of a woman by her clothes?	34%	20%	46%
3	Do men from mountains wear different clothes from men from plain?	69%	10%	21%
4	Do women from mountains wear different clothes from women from plain?	69%	10%	21%
5	Do you know whether a man is from city or village from his clothes?	55%	10%	35%
6	Do you know whether a woman is from city or village from her clothes?	51%	9%	40%

THE DISCOURSES OF SOCIAL CLASS IN KURDISH TRADITIONAL CLOTHES				
No.	Questions	Yes	No	Maybe
1	Can you distinguish the rich people from the poor through their clothes?	56%	13%	31%
2	Can you distinguish educated people from uneducated ones through their clothes?	28%	34%	38%
3	Can you distinguish literate people from illiterate ones through their clothes?	15%	38%	47%
4	Can you distinguish high ranked officials from others through their clothes?	44%	14%	42%

ranked officials from others through their clothes or not, some of the participants, 44%, say that they can do that, 42% are not sure (maybe) and 14% admit that they cannot distinguish high ranked officials from others through their clothes.

### The results of analysing the photo albums

The content of the photo albums conform to the results of the site visit analysis and the survey. The differences can be summarized as follows:

- One thing was found which is different to the materials of the museum which is hijab and scarfs. It seems that in the past few decades, under the influence of Islamic movements in Iraqi Kurdistan Region, women wear a kind of hijab which are close to the Arab and Muslim world clothes.
- Traditional Kurdish men dress varies according to the community they belong to. Since the photo albums contained clothes from all parts of Kurdistan, Men's clothes' colour, design and even names in Iraqi Kurdistan Region is different from the other parts of Kurdistan. In this region the main dress of men is a kind of outfit called "Rank u Chokhar", which is regarded as an iconic and a prototype for Kurdish traditional clothes in general. In this part of Kurdistan, wide trousers are favoured.
- In national festivals, especially in Nawroz, the beginning of Kurdish New Year and the beginning of spring, people dress special clothes as an indication of national belonging and beginning new life.
- Modern Kurdish textiles, which are found in the photo albums, are originated from the traditional ones. They contain traditional characteristics often complemented with new elements of western clothes and they are designed according to the desire of individuals. They discourse may embrace westernization, modernization and internationalization.
- The Kurdish traditional clothes were worn everyday by some people in their daily life, for work and leisure times, at the present time some people wear them in their daily life not only in festivals and occasions, especially the older generation and people from countryside, but younger generation and urban people wear these dresses only for special occasions.
- In the past and even in the present Kurdish women put on accessories and gold jewellery with the traditional clothes, because it is a sign of wealth and social status.

- The younger generation of women tends to wear brightly coloured clothes, while the older generation wears darker colours. This may be not true for men, since both generations tend to wear same colours. The colour of the Kurdish dress can be regarded as a symbol of tribe, alliance, region, or political party.

### CONCLUSION

The following conclusions can be drawn from the study:

- The main purpose of wearing textiles in the beginning of the history of humankind might be protection and covering, but nowadays these clothes convey messages. They have codes, signs and symbols that imply meaning, ideas, discourse and concepts.
- National identity is decoded in the textiles of many nations or ethnic groups. Kurdish traditional textile can be dressed in different occasions in different periods of time. In national festivals, especially in Nawroz, the beginning of Kurdish New Year and the beginning of spring, people dress special clothes as an indication of national belonging and beginning new life.
- Textiles can have transnational dimensions too. For Kurds transnationalism can include two dimensions. On the one hand, since Kurds do not have a nation-state and they live in their host countries, such as Turkey, Iran, Iraq and Syria, transnationalism feeling is expressed through their textile that can gather all of them together. On the other hand, diaspora Kurds who are scattered outside Middle Eastern countries in Europe or America, they wear the same clothes in special occasions to preserve their national identity.
- With regard to generation differences, most of the older generation wears Kurdish traditional clothes, compared to the younger generation. The elderly may find pride in their traditional clothes; they have not been affected by the modern trend of preferring western style in clothing. The effect of the host country style and westernization on the younger generation is more prevalent.
- Gender and textiles are interrelated; women like to wear more different and colourful dresses than men. Through their clothes, women want to send messages showiness, cover-up and disclosure. Men's textile is different from that of women. This

may be related to ethnic group norms and traditions; how the societies see the suitable clothes for men and women within their culture considerations. The focus is more on women's clothes rather than men in these cultural norms and tradition. It seems that in the past few decades, under the influence of Islamic movements in Iraqi Kurdistan Region, women wear a kind of hijab which are close to the Arab and Muslim world clothes.

- Kurdistan geo-cultural landscape has affected the way people design and wear clothes. Some type of clothes can convey the geographical identity of their users. For example, people from mountains wear different clothes from those living in plain areas and the dress of urban residents are different from countryside residents' dresses.
- Social status which is the honour or prestige that attached to someone in a certain social position or rank can be shown through textile. Throughout history high ranked and rich people wear different clothes. They want to separate themselves from lower and poor people. Their dresses send various messages to their surroundings to say that their political, economic or social status is higher than the others.
- The relationship between discourse and clothes are reciprocal, since discourse adds new meanings to clothes and vice versa. Each piece of Cloth, fibre or textile has its special discourse. People send messages by wearing different types of clothes in different occasions, rituals and even in their daily life.

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# Contemporary customized clothes using folk motifs

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## ABSTRACT – REZUMAT

### Contemporary customized clothes using folk motifs

*More and more consumers are attracted to fashion brands that make an extra effort to offer them personalized experiences. The unique details, as well as the complexity of the decorative elements of the folk costume inspire the fashion designers to return to the folk motifs, which they reinterpret and resize while integrating them in the contemporary space, offering models adapted to the customers' tastes, sizes and preferences and at the same time to make mass customization a profitable production. This study addresses the issue of personalizing clothing items with folk motifs.*

*In order to collect information on consumer satisfaction regarding the use of folk motifs in contemporary clothing, an online survey about the clothing available on the market and about personalized clothes with folk motifs was developed and applied. The survey was applied to a number of 548 respondents from Romania, Bulgaria, Canada and Spain. To determine the correlation between the answers to the questions for the four countries and to analyse the answers in each country, the PCA method was used. Based on the answers to the survey, certain motifs from the folk costumes were selected, reinterpreted in a modern way and inserted in two fabric patterns. The fabrics were produced on a Loom Jacquard SMIT Textile GS900.*

**Keywords:** *customized clothes, folk motifs, woven fabrics, survey, customer's satisfaction, Principal Component Analysis (PCA)*

### Utilizarea motivelor tradiționale în îmbrăcămintea contemporană personalizată

*Din ce în ce mai mulți consumatori sunt atrași de brandurile de modă, care fac un efort suplimentar pentru a le oferi experiențe personalizate. Detaliile unice, precum și complexitatea elementelor decorative ale portului popular îi determină pe designerii vestimentari să se reîntoarcă la motivele folclorice, pe care le reinterpretează și le redimensionează, integrându-le în spațiul contemporan, oferind modele adaptate gusturilor, dimensiunilor și preferințelor clienților, încercând, în același timp, să facă din personalizarea în masă o producție profitabilă. Acest studiu abordează problema personalizării obiectelor vestimentare cu motive folclorice.*

*Pentru a colecta informații despre satisfacția consumatorilor cu privire la utilizarea motivelor populare în îmbrăcămintea contemporană, s-a realizat și aplicat un chestionar online despre îmbrăcămintea disponibilă pe piață și despre îmbrăcămintea personalizată cu motive populare. Chestionarul a fost aplicat unui număr de 548 de persoane din România, Bulgaria, Canada și Spania. Pentru a determina corelația dintre răspunsurile întrebărilor pentru cele patru țări și pentru analiza răspunsurilor din fiecare țară în parte, a fost utilizată metoda PCA. Pe baza răspunsurilor chestionarului, au fost selectate anumite motive din costumele populare, au fost reinterpretate într-un mod modern și au fost inserate în două modele de țesături. Țesăturile au fost produse pe un Loom Jacquard SMIT Textile GS900.*

**Cuvinte-cheie:** *îmbrăcămintă personalizată, motive tradiționale, țesături, chestionar, satisfacția consumatorului, Analiza Componentelor Principale (PCA)*

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## INTRODUCTION

Authentic folk costumes [1] are not only of great beauty, but they also represent a landmark of the cultural identity of a people, a precious artistic, social and historical document.

The progress of modern society has occurred not without paying a price: the elimination of the folk costumes from their daily use, so that today they can only be seen at folklore events, craft fairs or in museums.

Fortunately, in recent years, we are witnessing an increasing interest in traditional motifs [2, 3] and their

re-investment in modern clothing. Young fashion designers have understood that their duty is to find solutions to capitalize the folk motifs through modern technologies [4], so that, by re-interpreting and re-contextualizing them, our cultural heritage can be restored at the same time.

This paper aims to investigate design themes and recommendations purposed to be inspirational and guiding for fashion designers and manufacturers who want to incorporate folklore components in their designs, and used as a retrospective lens for experienced folklore elements for personalized clothing



designers to evaluate their existing creations for exploring alternative paths towards new designs.

## LITERATURE REVIEW

### Key elements of traditional folk fashion

Lifestyles and consumption patterns have changed significantly with mass production and the loss of identity but in the recent decades, in the context of assertion of cultural identity, society's interest in folk costume has increased. Folk inspired trend connects people to their past. The return to ethnic motifs and elements highlights the importance of cultural and social archetypes, which were developed during important historical periods and have preserved their meaning and essence until the present time [5].

Starting from the idea that every piece of clothing in the traditional costume has a story behind it, and that this story should not be forgotten, but should be made known to all, the authors of this study have set out to remind the importance of tradition and cultural heritage, in an increasingly globalized and industrialized world. It is important for clothes with folk elements details to gain more and more ground, and clothes inspired by traditional motifs will be appreciated especially in urban fashion, where these elements are disappearing.

Often, we are afraid that if we keep the elements of tradition alive, we will be considered outdated or old-fashioned by the new trends. That is why, when purchasing new wardrobe items, we usually focus on fashionable clothes or accessories. However, over time, they become less popular or they start to become outdated and so we stop wearing them. Therefore, when it comes to creating a wardrobe, it is best to invest in a few classic clothing items, which not only will not be outdated, but also give us the opportunity to combine them in a series of always trendy and elegant outfits. Some simple attire, such as a white button-down shirt, can be worn in so many different ways throughout any season, but if you added, for example, embroidery with folk motifs, this trivial piece of clothing could then turn into a special garment. In the same way, designers can integrate traditional motifs into their creations, combining old elements with new and original ones, to finally create bold pieces that can be worn to even the most sophisticated events.

Traditional motifs need to be re-invented and cultural background should not be forgotten. It must not only be re-invented with respect to traditions, but it must be restored to the modern times. Clothes with folk elements details can become statement items that could be integrated into outfits for special occasions too. These can be integrated into daring youth outfits, perfect for everyday fashion and if properly integrated, the traditional models are even cool for the younger generation. In an industrialized world, where clothes are made in large series, we consider that it is very important that the emphasis should be placed on the unique garments.

### Mass customization

The studies on this subject show that the focus in the fashion apparel industry is on "exclusive experience", while the global keywords in most industries set off push factors of product standardization. At the same time, consumers are more than ever before demanding of products, services and brands and will no longer settle for the mass offerings suggested by many distributors. Whatever they purchase, they wish it had a personal touch. The concept of mass customization aims at offerings that best serve the individual customer's needs [6] and some segments of customers at the same time [7]. Custom-made clothing requires a good understanding of the expectations and particularities of each individual [8].

According to Pine [7], the success of personalization and mass customization rests mainly on the integration of the competitive advantages of the value chain. Businesses must achieve success by operating well on different axes that are commonly on different sides in most businesses: maintaining short supply lead times, talk time and cycle time while offering custom-made products that correspond to customers' specifications. In global economy where the competitive pressure is very high, the textile and fashion apparel manufacturers are forced to lower production costs and increase their efficiency. Nowadays, the fashion industry has to deal with labour efforts for production processes, small quantities with few repetitions, frequently changing styles and short delivery times. Moreover, customer demands determine the aesthetic design [9] and the functional requirements of the clothing regarding its usefulness and lifespan. In the fashion industry, the firms try to produce, adjust, sell, and deliver, in a systematic and automated fashion, personalized and made-to-measure products. [10].

It becomes important to use well mass customization tools when buying clothes online [11]. The product configuration is essential for an effective implementation of mass customization as it creates possibilities to guide the customers while they are making choices. Haug et al. [10] affirm that configurator's main objective is to ease the decision-making process of customers using a Web-based interface. The importance of interactive, digital and 3D technology programs cannot be denied but the major issue for the clothing brands is to find solutions for sizing and fit [12].

The literature review led to a certain framework for the entire study. Independent variables were technologies design elements, which were separated into ten aspects: context, content, community, origin, style, fabric, details, customization level, communication, and distribution.

Similarly, the dependent variables can be defined as customer needs for design participation; in this study, these are divided into two aspects: i) **consumer satisfaction** based on clothing types available on the market with folk elements details and if the style of clothing is a source of concern for the consumer;

ii) **consumer innovation** based on **the difficulty** of finding well-fitting clothes with folk element details, including the aspect of co-design tools and the desire to modify, stylize or personalize his clothes. If they are willing to pay more for clothes with fashion folk details and interest in having more influence on the design of the clothes they buy. Even more, they would like to be more creative in the folk art of fashion and thus have clothes with a strong identity from folk details.

## MATERIAL AND METHODS

An online consumer survey aimed at collecting information about the customer's satisfaction about the folk elements (print, embroidery, etc.) within fashion clothing available on the market and on customized clothes with fashion folk details was carried out between January and March 2020.

The survey covered 548 respondents spread over four countries: Romania, Bulgaria, Canada, and Spain. Respondents were randomly selected regardless of education, employment and gender. All respondents were aware of the purpose of the survey and the purpose of using the data received. The survey was conducted on-line. For its creation, Google forms (Google Inc.) were used. It had three types of questions: two questions about consumer satisfaction and innovation; one open-ended question; one Yes/No question.

### Questions for analysis of consumer satisfaction (Q1)

(Q1.1) Overall, I am satisfied with clothing available on the market (stores and web);

(Q1.2) I am satisfied with the folk elements (print, embroidery, etc.) within fashion clothing available on the market;

(Q1.3) My style of clothing is a source of concern.

Possible answers: (A1.1) Very dissatisfied; (A1.2) Mostly dissatisfied; (A1.3) Neither satisfied nor Dissatisfied; (A1.4) Mostly satisfied; (A1.5) Very satisfied.

### Questions for analysis of consumer innovation (Q2)

(Q2.1) Overall, I have trouble finding well-fitting clothes;

(Q2.2) I have trouble finding nice clothes with folk elements (print, embroidery, etc.) on the market (stores and web);

(Q2.3) If possible, I would like to modify, stylize or personalize my clothes;

(Q2.4) I would be willing to pay more for personalized and well-fitting clothes;

(Q2.5) I would like to buy customized clothes with fashion folk details;

(Q2.6) I would like to have more influence on the design of the clothes I buy;

(Q2.7) I would like to be more creative in the folk art of fashion and have clothes with a strong identity from folk details.

Possible answers: (A2.1) Strongly disagree; (A2.2) Somewhat disagree; (A2.3) Neither agree nor disagree; (A2.4) Somewhat agree; (A2.5) Strongly agree.

### Open-ended question (Q3)

What is the most important if you personalized your own clothes?

### Yes/No question (Q4)

Do you know something about the co-creation/co-design approach: the process of the creation of clothing by customers?

The process of co-creation is active, creative and social collaborative and it involves the producers as well as the users, which goals to create value for customers [13]. According to [14] and [15], the most important principles of co-design process are: 1) to provide a variety of choices to customers; 2) to use an illustrating tool to show sample products before committing to the purchase; 3) to interpret the specification and materials, details and parts of each order so that the products exactly meet the customers' needs.

## RESULTS AND DISCUSSION

### Survey data analysis

The PCA method [16–17] was used in order to determine the correspondence between the answers of the questions for different countries and for analysis of answers from each country separately. The advantages of PCA are that it removes correlated features, improves algorithm performance, and of course improves visualization. The method is an appropriate tool to analyse the relationships among the variables of survey data.

Principal components were calculated by rows and columns of the table with answers and the results were presented graphically. The data were processed in Matlab 2017 environment (TheMathWorks Inc.). All data were processed at level of significance  $\alpha = 0.05$ .

Figure 1 shows the results from PCA about answers of Questions Q1 and Q2 in different countries. First two principal components describe 93% of data variance. 86% of data variance of Q2 is described by its first two principal components.

As can be noticed in the diagrams in figure 2, the distribution of answers is not uniform regarding the questions for analysis of consumer satisfaction (Q1) with clothing available on the market and with the folk elements (print, embroidery, etc.) within fashion clothing available on the market. In Romania and Bulgaria, the level of consumer satisfaction is much higher than the one registered in Canada and Spain. In Romania, 69% of the number of respondents and in Bulgaria 66% of the respondents are satisfied and very satisfied with clothing available on the market and with the folk elements (print, embroidery, etc.) within fashion clothing available on the market where as in Canada the percentage is only 40% and in Spain 52%.

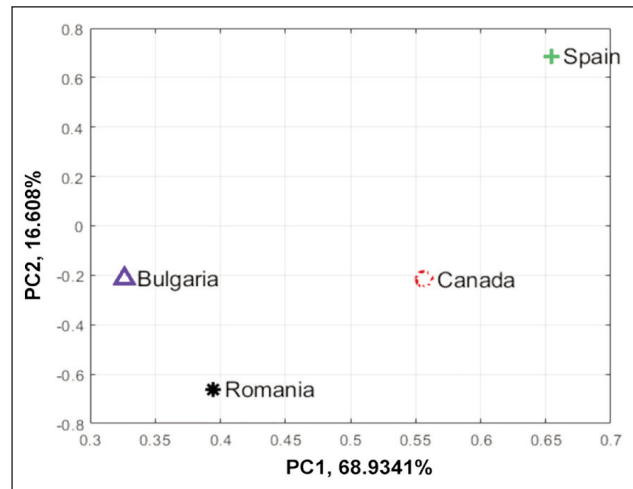
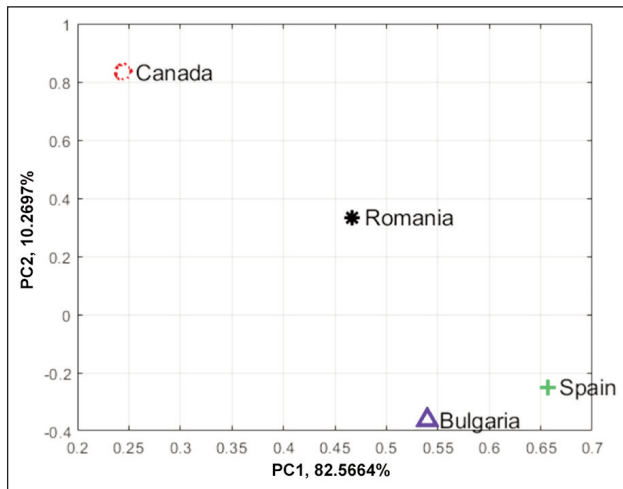


Fig. 1. PCA of answers of Q1 and Q2 for different countries: a – Question Q1; b – Question Q2

This could be explained by the fact that in recent years, both in Romania and Bulgaria, the traditional motifs have experienced an enchanting comeback. Renowned designers have included in their collections creations that pay tribute to the traditional costumes of these countries. The Romanian folk traditional blouse was re-interpreted and matched with the most modern clothing accessories, thus becoming a must have of the local wardrobe.

The low level of consumer satisfaction in Canada and Spain is due to the lack of innovation in the market. It seems difficult to find trendy clothes available on the market and with representative folk elements. This in itself is a headache for the North American market, looking for a traditional product, but with certified fair-trade options. What is available is more for tourists and specific events, but not fashionable. For various reasons, small companies in Spain also seek to manufacture their products in a fair and sustainable way.

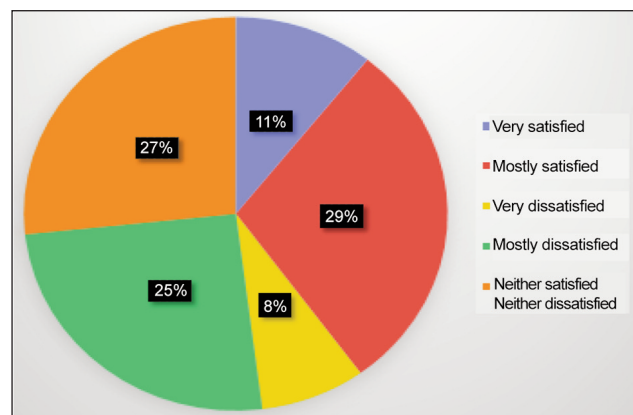
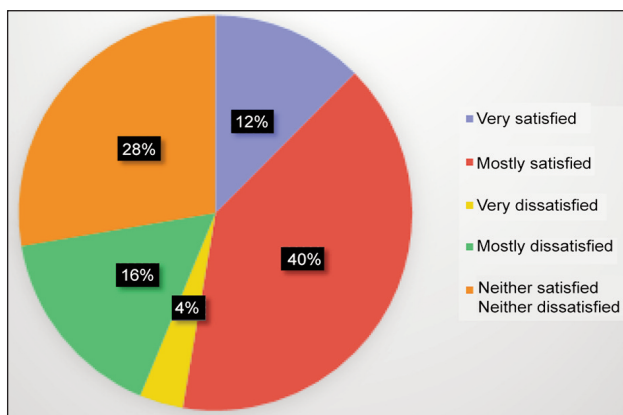
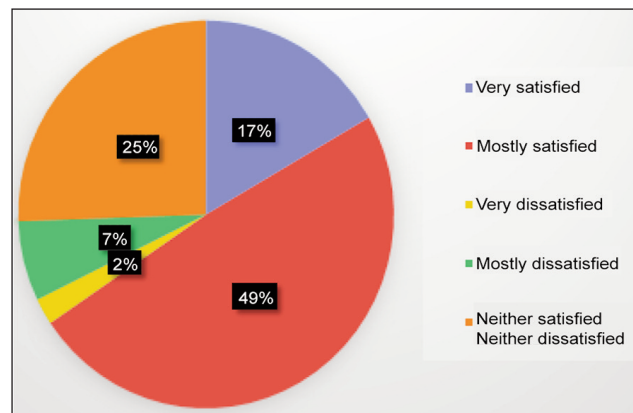
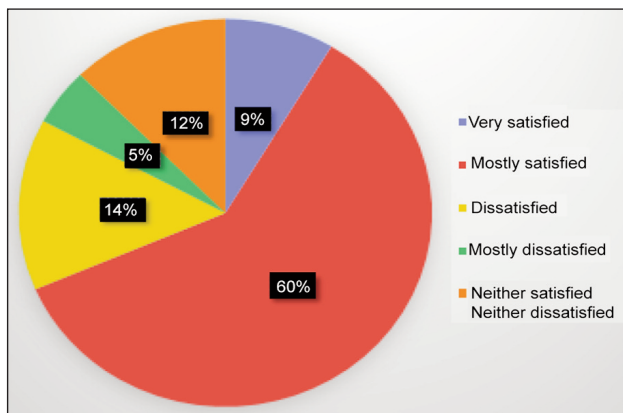


Fig. 2. Answers to question Q1: a – Romania; b – Bulgaria; c – Spain; d – Canada

However, just like Canada, the attractiveness of the fashion folk traditional products is not there. Spanish designers do not offer collections inspired from traditional Spanish motifs even though Spain has an important historical legacy. Different traditions between Spanish territories show significant differences between them, for example Andalusia, Aragon, Catalonia, Valencia, etc., but those differences have not yet been considered as ornamental motifs for fashion designers.

In reality, the results confirm that some consumers simply do not identify with the models and styles offered on the market. On the other hand, we need to underline that the printed and patterned market is growing, and that the consumer's interest seems to lean more towards the purchase of interpretations of traditional models like those of aboriginal and indigenous countries, and less in promoting or identifying with a particular ethnic identity.

In the second part of the questionnaire, (Q2) referring to the analysis of consumer innovation the distribution of answers is uniform in Romania, Bulgaria and Spain, exception being made for Canada.

As can be seen from the graphs in figure 3, consumers in Romania and Bulgaria reported problems with finding the right clothes and clothing items decorated with folk items. In these countries, the customers have expressed their desire to purchase personalized clothes and to have a greater influence on the design of the clothes they purchase. The interest in personalized clothes with folk motifs and the willingness of consumers to pay more for these types of

products is also noticeable. In Spain, consumers have problems with finding the right clothes and express their desire to customize them, to influence their design and they are willing to pay more for such clothes. With regard to clothes adorned with folk motifs, it was found that in general there are no problems with finding such products. Compared to the responses received from the consumers from Romania and Bulgaria, a large part of the consumers in Spain is not interested in getting involved in creating clothes with folk details.

Responses received from Canadian consumers revealed that they generally did not encounter problems with finding the right clothes or the ones with folk motifs, but the Canadian consumer's interest in personalized and popular motifs is much lower than in Romania, Bulgaria or Spain. One of the main reasons is that, the folk motifs, patterns and design are less developed which creates a lower appeal for Canadians, except for native indigenous people, Inuit, Innu with folk design.

Regarding question Q3, from the data analysis we can notice that from the point of view of the respondents (Romania, Bulgaria, Spain and Canada), the most important aspects regarding the possibility of personalizing their clothing are related to the aesthetic component, the technical and functional component and the ergonomic component.

The colour and the colour combinations are what they would like to be able to customize for 13% of the respondents; the quality of the fabric – 14%, the texture of the materials – 7%, the fit and right size –

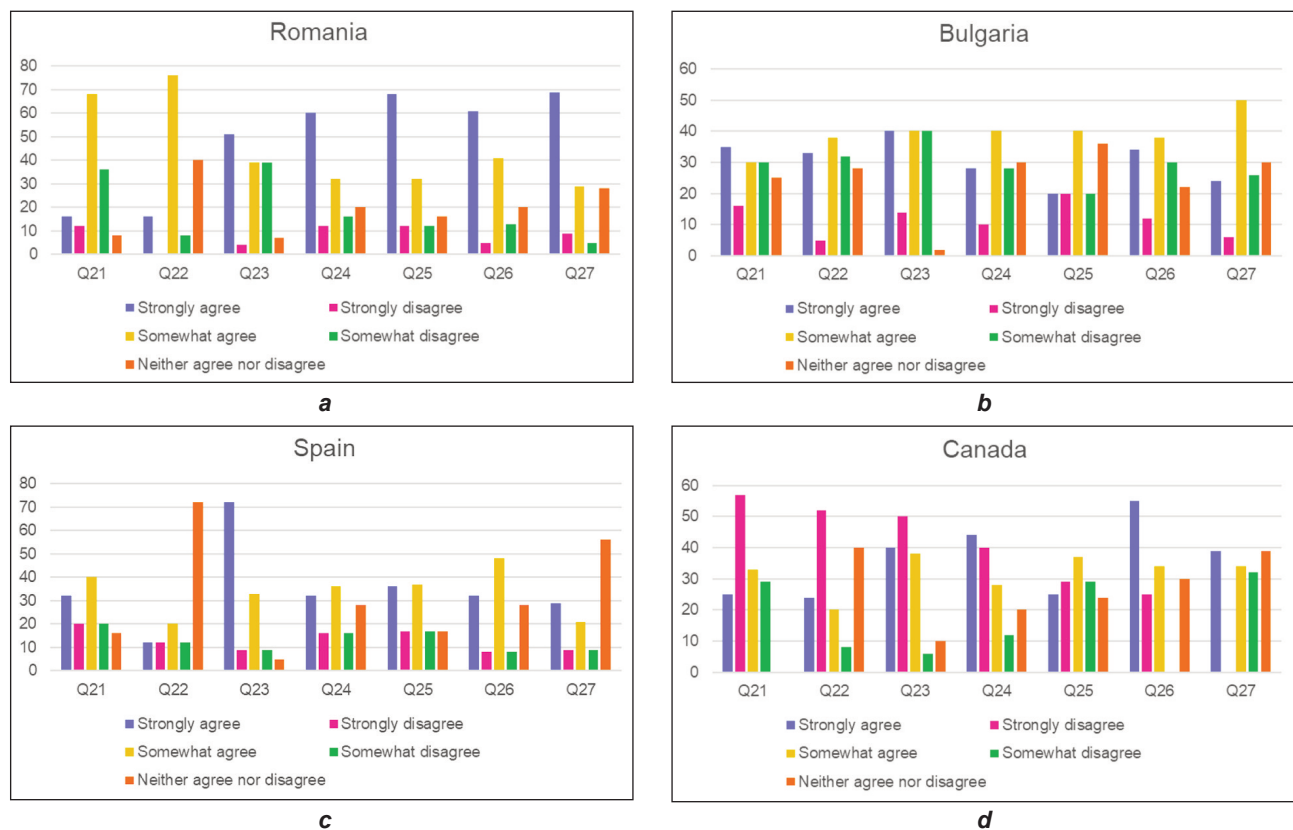


Fig. 3. PCA of answers to question Q2: a – Romania; b – Bulgaria; c – Spain; d – Canada

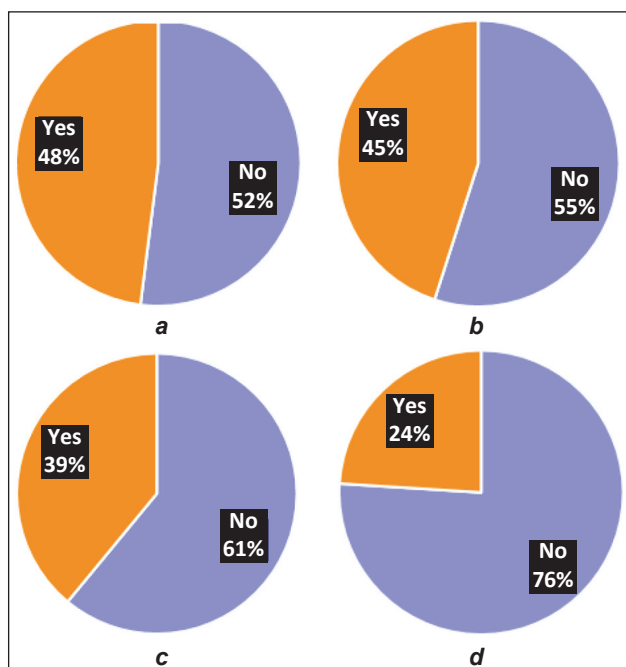


Fig. 4. Answers of question Q4: a – Romania; b – Bulgaria; c – Spain; d – Canada

26%, the comfort – 19%. A ratio of 21% of the answers the people are looking for bohemian vibes like dress and blouse with delicate embroideries and fancy print with fashionable folk details.

The answers to the question “Do you know something about the co-creation/co-design approach: The process of the creation of clothing by a customer?” highlighted that in all countries the notions related to co-creation and co-design are less known by consumers (figure 4).

Our research has certain limitations that should be emphasized and there are, in fact, many possible avenues for future investigation. First, due to a concern for simplification, we refrained from integrating other characteristics related to a manufacturer and designer that could have been relevant for example: the technical difficulties, know-how, capabilities, and fast fashion sectors. Besides, the fact that our research does not focus on a single category of business and products also has an impact on the external validity of our results.

#### Creation of custom designs by using folk motifs

Based on the answers of the questions 2 and 3 and inspired by the embroideries of folk costumes, the motifs taken from the traditional costumes have been reinterpreted in a modern way and have been inserted into two fabric designs. The influences of urban fashion can be seen in the geometric and floral models used. The old elements have been combined with some new and original ones, resulting in two bold materials, which can be worn even at the most sophisticated events. They combine the urban style with the traditional motifs taken from the traditional folk costumes. The fabrics were produced on a SMIT Textile GS900 Jacquard Loom. The fabric ornamentation was obtained through its own weaving process. Both

materials are perfect in order to adopt a very different style pattern and they combine the urban style with the traditional motifs taken from the traditional costume. To visualize the virtual garment and to simulate fabrics drape and fit, different tools and functions of Vectary free online tool (<https://www.vectary.com>) were used (figure 5).

Vectary is a versatile application that can be used to create visually appealing 3D designs. To accelerate the design process, the keyboard and shortcuts of the application were used. It was possible to modify and create personalized objects with a professional output by drag & drop 3D models onto the scene. The personalized objects can be exported into 3D file formats, embedded in custom web page. Some Vectary’s tools (modifiers, deformers, generators, and parametric primitives) were used to create and to edit 3D models.

This fashion simulation might resemble a stylish puzzle, made out of numerous key pieces that once put together do not assure an impeccable take on the trend (impeccable application but aesthetically good as a result).



Fig. 5. Creation of Custom design by using folk motifs

#### CONCLUSIONS

The trend called “customized clothes with folk motifs” will lead to an important renewal in the fashion apparel industry. The main particularities of this trend are personalized, stylish folks, shorter life cycles, quick response production, more specific customer preferences, and lifestyle purchasing. These characteristics will constrain the supply chain to create not only great opportunities, but also new challenges in fashion industry. This trend of revisiting the roots or back-to-the-land movement can be accomplished through personalization and mass customization, since its primary goals include quick response to fashion and customer’s needs. The problem is not the quick response or in technology but the interpretation of drawings and the transfer of motifs: know-how. The notion of co-design becomes important in our case study. It remains to be seen if the consumer can

figure himself a design of folk motif adapted to what he wants and what he will eventually benefit.

- From the point of view of the actors of the fashion, the report is unanimous: the fashion with the traditional reasons should resume vigour.
- It is a fundamental folk trend, which is going to be accentuated, and to which it is imperative to adapt (more so for some countries).

The concepts of co-creation, co-design, personalization and mass customization give occasion to meet, even exceed, customers' expectations. Personalized clothing can help customers experiment with items

with folk motifs they normally would not try to feel confident with how an item looks on their body before they place an order. These technology and digital approaches capitalize on comfort and convenience, which are priorities for innovating shoppers. The approach can create a real differentiation value for the manufacturer which is derived from focusing on its core competencies and from outperforming competitors on the market. However, the voice of the customers is crucial. They are sensitive to the relationship they can have with the product and the aesthetic aspect and the intrinsic part of cultural identity.

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# Determinants of online clothing review helpfulness: the roles of review concreteness, variance and valence

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## ABSTRACT – REZUMAT

### Determinants of online clothing review helpfulness: the roles of review concreteness, variance and valence

Online reviews have emerged as an essential information source for online clothing purchasing behaviour. It is thus paramount for marketers to understand what makes online clothing review helpful to consumers. This research primarily aims to examine the relationship between review textual content factors and review helpfulness in the context of online clothing purchasing. Experiments on review concreteness (concrete or abstract), review variance (consistent or inconsistent) and review valence (positive or negative), between participants were conducted to explore the interaction effect. The findings suggest that online clothing review concreteness, variance and valence are significant factors affecting review helpfulness. Additionally, this study's findings show that abstract review, negatively review and inconsistent review has a stronger effect on online clothing review helpfulness than concrete review, positively review and consistent review. The findings will help customers to write better clothing reviews, help retailers to manage their websites intelligently and aid customers in their product purchasing decisions.

**Keywords:** online clothing review, review helpfulness, review concreteness, review variance, review valence

### Determinanții ai utilității recenziei online a îmbrăcăminte: rolurile concreteții, variației și valenței recenziei

Recenziile online au apărut ca o sursă de informații esențială pentru comportamentul de cumpărare online a îmbrăcăminte. Prin urmare, este esențial pentru specialiștii în marketing să înțeleagă ceea ce face utilă recenzia online a îmbrăcăminte pentru consumatori. Această cercetare își propune în primul rând să analizeze relația dintre factorii de conținut textual al recenziilor și utilitatea recenziei în contextul achiziționării de îmbrăcăminte online. Au fost efectuate experimente privind concretețea recenziei (concretă sau abstractă), variația recenziei (consecventă sau inconsecventă) și valența recenziei (pozitivă sau negativă), între participanți, pentru a analiza influența interacțiunii. Rezultatele sugerează că, concretețea, variația și valența recenziei online a îmbrăcăminte sunt factori importanți care influențează utilitatea recenziei. În plus, concluziile acestui studiu arată că recenzia abstractă, recenzia negativă și recenzia inconsecventă au o influență mai puternică asupra utilității recenziei online a îmbrăcăminte decât recenzia concretă, recenzia pozitivă și recenzia consecventă. Rezultatele îi vor ajuta pe clienți să scrie mai bine recenzii despre îmbrăcăminte, pe comercianții cu amănuntul să-și gestioneze site-urile web în mod inteligent și pe clienți în deciziile lor de cumpărare a produselor.

**Cuvinte-cheie:** recenzie online a îmbrăcăminte, utilitatea recenziei, concretețea recenziei, variația recenziei, valența recenziei

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## INTRODUCTION

Advance online communication technologies, and massive distribution of internet connection have transformed the traditional face-to-face word-of-mouth (WOM) communication to electronic word-of-mouth (E-WOM) communication. E-WOM refers to any positive or negative statement made by potential, actual or former consumers about a product or service, which is made available to a multitude of people and institutions via the internet [1]. Consumers can use various internet-based platforms such as retailers' websites, brand community, independent websites, consumer blogs etc., to share experiences and opinions about a product or service [2]. Online reviews are a form of electronic word-of-mouth (E-WOM) and provide information based on the posted personal

experience of previous buyers of a specific product working as free "sales assistants" to help other consumers identify the product that best matches their needs and preferences [3]. Online reviews are seen to be helpful for both potential customers and product manufacturers. To illustrate, on the customers' side, they can use online reviews to support their decision whether to purchase a particular product or not. On the other hand, for product manufacturers, they understand customers' current preferences from online reviews and utilize the knowledge in product development, marketing, and customer relationship management [4]. Indeed, a survey conducted by Nielsen among 28,000 Internet users from 56 countries reported that 70% of respondents considered online reviews a trustworthy source of information, ranking them as the second most trusted form of

advertising among 19 different choices. As a result, marketing practitioners are interested in learning how to effectively stimulate and manage online reviews [5]. A significant number of studies examined online reviews from different perspectives, such as their effect on consumer expectations, customer satisfaction determinants, psychological influences, and firm responses.

But, ironically, too much online reviews also leads to information overload and consequently, inferior decision making [6]. Consumers are looking for online reviews that can assist them in their decision making. Whether an online review contributes to product evaluation and purchase decision, in other words, its utility or diagnosticity, is commonly measured by the review "helpfulness" [7]. Consumers are more receptive to obtain helpful online reviews with little searching effort; it is imperative that consumers may have access to helpful online reviews. The perceived helpfulness of the information obtained from online reviews positively affects consumers' attitudes for decision making [8]. Therefore, Businesses search for practices that facilitate the generation of helpful reviews on their e-commerce or review site in order to enhance their value to users. To investigate factors that make online reviews helpful for buyers are an essential research question.

Customers' preference seemed to have started changing gradually, in favour of shopping products online in regards to clothing products. Fashion clothing houses are no longer expecting profitable growth and expansion by purely focusing on the traditional marketing strategies only, instead, in a favourable market condition, the firms' marketing mix requires the integration of online marketing tools as well. Online reviews have emerged as an essential information source for online clothing purchasing behaviour. Online clothing reviews are abundant, complex bundles of information that reflect consumers' experiences and evaluation of products. We draw research attention towards this important market as online reviews highly influence it. Clothing products have an experience goods attribute (experience goods refer to products whose quality can be ascertained only after a purchase), it is difficult to obtain information and to compare the product attributes, because consumers usually need to see physically, smell, touch, or use them, and different consumers are likely to form heterogeneous opinions based on a single product attribute. Although there are several studies investigating consumer information adoption, e-WOM, online review helpfulness, few studies are discussing the helpfulness of online clothing reviews. Investigating the perceived helpfulness of online clothing reviews is not only beneficial to consumers but also to retailers. Furthermore, no studies have been conducted so far investigating the independent effect of online clothing review concreteness, online clothing review variance and online clothing review valence on the helpfulness of online clothing reviews. This study seeks to fill this gap. The

findings are expected to provide a guideline for consumers on how to write a helpful review in response to clothing products and also provide insights for clothing retailers and fashion company on recommending helpful reviews to potential consumers.

The virtual environment forces consumers to evaluate online clothing reviews primarily based on their content. Content-related characteristics are found to be more influential than context-related characteristics for online clothing review helpfulness. This study aims to address an interesting but unanswered question: What is the influence of different review content related online clothing reviews helpfulness, with a specific focus on latent content variables on perceived review helpfulness? Does online clothing review concreteness, online clothing review variance and online clothing review valence influence the helpfulness of online clothing reviews?

The following research objectives are defined for this work:

- To examine the impact of review valence on perceived helpfulness of online clothing reviews;
- To examine the impact of review concreteness on perceived helpfulness of online clothing reviews;
- To examine the impact of review variance on perceived helpfulness of online clothing reviews.

The rest of the paper is organized as follows. We introduce the relevant conceptual framework and establish hypotheses in Section 1; Section 2 describes the research methodology (research design, pretest and data collection, manipulation check etc.) in detail followed by Section 3, which presents results and findings. Then Section 4 and 5 conclude with a discussion of the implications of our studies and suggestions for further research.

## LITERATURE REVIEW AND HYPOTHESES

### Literature review

Online review helpfulness. Online review helpfulness defines the perceived value of a review to its readers and measures consumer's evaluation of a review. It illustrates the degree to which a review contributes to a purchase decision by determining the level of its adoption by potential customers. In recent years, research on the helpfulness of online reviews has become a hot topic and focus. Academic researchers have advocated the benefits of helpful reviews and identified traits of a helpful product review. An increasing number of studies have explored factors that influence online review helpfulness. These factors include the content and context characteristics of the review. Content characteristics refer to the features that are derived from the review content, including review length, and review emotion. The context characteristics refer to the features, including reviewer expertise and reputation, review extremity, and reviewer disclosure [8]. Some scholars found that a review's extremity, review depth, and product type affect its perceived usefulness [9]. Generally speaking, consumers are influenced by both types of attributes



when deciding which reviews to consider and which to reject.

**Online review concreteness.** Online review concreteness is a semantic feature representing what kinds of words are generally used in a message. Within the context of online clothing reviews, review concreteness can be seen as a type of textual content specificity ranging from objective facts (concrete) to abstract and emotional content based on subjective experience (abstract). From a communication standpoint, review concreteness is expected to be an important feature for online review perceived helpfulness. A number of studies have found the influence of textual concreteness on individuals' perception. Previous studies measured review concreteness using the text length (word count) and, thus, the concept of concreteness was oversimplified; however, the present research used the original concept of concreteness by manipulating the textual content of online reviews to be concrete or abstract. As such, it is argued that online review concreteness is a useful concept that allows us to understand how shopping experience could be represented through semantic features in online clothing reviews and, consequently, how it could impact on consumers who are seeking information for decision making.

**Online review valence.** Online review valence also referred to as review ratings, which is the positive and negative orientation of information that represents the reviewer's general opinion towards a product or service. The measurement of review valence can be obtained by average value of review score or can be identified directly by review text evaluation. Online review valence is a critical factor that affects product sales [10]. A number of studies have examined the influence of review valence on consumers' producer service evaluations. Researchers hold different views on the effect of positive and negative reviews on consumer behaviour. In comparing positive online reviews, some researchers found that negative online reviews have a considerable effect on consumer responses because they can find information about specific problems other consumers may encounter when using the products. Customers tend to pay more attention to negative than positive reviews. Scholars argued that people regard negative reviews as more helpfully, and they respond more saliently to them than to positive ones [11]. This relationship is also moderated by brand strength, with positive online reviews exerting a greater influence on products with weak brands [12].

**Online review variance.** Review variance refers to the extent to which message content is consistent with or similar to others regarding the same product or service. Cheung et al. [13] measured review variance through the degree of consensus and similarity with other reviews of the same product. Consensus with the aggregated rating on websites also indicates the variance of review rating. Information in online review in high different with those provided by other reviewers is perceived as helpful. People likely believe information when the content is inconsistent across

different sites and sources. Studies found that online review variance positively affects the perceived helpfulness.

## Research hypotheses

Based on the above discussions, the following hypotheses are proposed for further examination.

- H1. Online clothing review concreteness is significantly influences to review helpfulness.
- H1a. The effect of review concreteness on online clothing review helpfulness is differential; compared with concrete review; abstract review has a stronger effect on online clothing review helpfulness.
- H2. Online clothing review valence is significantly influencing to review helpfulness.
- H2a. The effect of review valence on online clothing review helpfulness is differential; compared with positive review; negatively review has a stronger effect on online clothing review helpfulness.
- H3. Online clothing review variance is significantly influences to review helpfulness;
- H3a. The effect of review variance on online clothing review helpfulness is differential; compared with consistent review; inconsistent review has a stronger effect on online clothing review helpfulness.

## METHODS

### Research design

Experimentation is appropriate as it allows for the manipulation of one or more independent variables and measurement of their effects on dependent variables. To control for potential confounding factors, such as unwelcome environmental interruptions, we opted to conduct the experiment in a controlled laboratory setting. Experiments on review concreteness (concrete or abstract), review variance (consistent or inconsistent) and review valence (positive or negative), between participants were conducted to explore the interaction effect. The dependent variable was online clothing review helpfulness. We chose a fictitious brand name for the clothing in this study because we did not want the brand to influence the review evaluation. Review contents were adapted to actual reviews of *mogujie.com*, the famous website for online clothing purchase in China. Participants first read an online shopping scenario involving the purchase of clothing for them. They were instructed to imagine the situation as if it really occurred to them. All measurement instruments in this study were adopted and adapted from prior studies.

A pre-test was conducted to assess whether the research protocol was feasible, and if the measures of the study variables were effective. In total, 20 students from a university in China were invited to join the pilot test on a voluntary basis. To ensure validity, respondents were asked whether they thought the statements measured the corresponding variables after finishing the survey. Feedback regarding the selection of garment was recorded. Modifications

were made to improve scenarios and the revised questionnaire was used in the main survey. We recruited Chinese university students to participate in the experiment because they constitute an important segment (a major portion) of online clothing shoppers in China. A total of 275 students from a large public university in China participated in the experiment; these students have experience of purchasing clothing products online. A few cases were removed as a result of incomplete or untrustworthy responses, resulting in 269 cases for analysis. The participants were randomly assigned to eight treatment groups. Participants' average age was 20.92 years, and 59.1% of the subjects were female.

The collected data were analysed using the statistical package for the social sciences software. A two-step approach was applied for data analysis. The first step aimed to ensure content validity and reliability. To ensure content validity, the measurement items were adopted from prior studies. Cronbach's alpha was computed from the data to ensure guarantee internal consistency and reliability. The second-step sought to address the research objectives and test the hypotheses. A three-way analysis of variance was applied to explore the main and interaction effects of online clothing review concreteness, online clothing review variance and online clothing review valence on online review helpfulness.

### Manipulation check

We assessed the success of the manipulation of the independent variables with a few questions. We verified online clothing review concreteness manipulation by asking the subjects to rate the following measurement item on a five-point Likert scale: "The review I read describes the details of the products." The results showed that the manipulation was well

achieved. The independent t-test for review concreteness suggested that the manipulated online clothing reviews as concrete or abstract were perceived as intended ( $M_{concrete}=4.45$ ,  $M_{abstract}=1.13$ ,  $t=10.75$ ,  $p<0.01$ ). By asking the subjects about whether the review was consistent with other reviews; the results showed that the review consistent manipulation was well achieved ( $M_{consistent}=4.32$ ,  $M_{inconsistent}=1.25$ ,  $t=11.530$ ,  $p<0.01$ ). By asking the subjects about whether the review was positive; the results showed that the review variance manipulation was well achieved ( $M_{positive}=4.48$ ,  $M_{negative}=1.49$ ,  $t=9.230$ ,  $p<0.01$ ). These suggested a successful manipulation. Perceived online clothing review helpfulness, the dependent variable, was measured using three measurement items adapted from Huang et al. [10]: (i) "This review improves my ability to make a decision on whether or not to buy this product"; (ii) "This review provides me with insights into whether or not I would like this product"; and (iii) "The review contains useful information about this product". All of the items are reflective indicators and were measured on a five-point Likert scale, where, 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree (Cronbach's alpha = 0.74).

### RESULTS

We ran ANOVA analyses using online clothing review helpfulness as the dependent variable. As shown in table 1, the main effects of online clothing review concreteness ( $F=13.804$ ,  $p=0.005$ ); online clothing review valence ( $F=55.511$ ,  $p=0.000$ ); and online clothing review variance ( $F=57.846$ ,  $p=0.000$ ) were statistically significant. Results indicate that review content attributes including review concreteness, valence, and variance are significant factors affecting online clothing review helpfulness. Hence, H1, H2,

Table 1

TEST OF EFFECTS ON ONLINE CLOTHING REVIEW HELPFULNESS					
Source of variation	Type III sum of squares	Df	Mean square	F-ratio	Sig.
Corrected model	266.029	7	3.244	72.53	0.000***
Intercept	1478.034	1	1478.034	1152.82	0.000***
Online clothing review concreteness	19.511	1	4.878	13.804	0.005**
Online clothing review valence	28.263	1	7.066	55.511	0.000***
Online clothing review variance	40.235	1	3.402	57.846	0.000***
online clothing review concreteness * online clothing review valence	51.028	1	1.895	42.653	0.001***
Online clothing review concreteness *online clothing review variance	2.432	1	2.917	2.478	0.114
Online clothing review valence *review variance	40.833	1	1.123	12.275	0.006**
Online clothing review concreteness *online clothing review valence *online clothing review variance	2.203	1	1.282	1.876	0.643
Error	303.858	252	-	-	-
Total	5642	260	-	-	-
Corrected total	569.888	259	-	-	-

Notes:  $R^2 = 0.767$ ; Adjusted  $R^2 = 0.728$ ; \* significant at 0.05 level; \*\* significant at 0.01 level; \*\*\* significant at 0.000 level.

MEANS AND STANDARD DEVIATIONS OF ONLINE CLOTHING REVIEW HELPFULNESS				
Indicator	Experiment manipulation	Online review helpfulness (N=260) Mean(SD)	F-ratio	Sig.
Review valence	Positive	3.91(0.49)	53.89	0.000***
	Negative	4.69(0.55)		
Review variance	Consistent	4.05(0.58)	45.47	0.000***
	Inconsistent	4.62(0.62)		
Review concreteness	Concrete	3.83(0.55)	63.86	0.000***
	Abstract	4.68(0.57)		

Notes: \*\*\* significant at 0.000 level.

H3 were supported. The two-way interaction of online clothing review concreteness and online clothing review valence ( $F=42.653$ ,  $p=0.001$ ), and the two-way interaction of online clothing review valence and review variance ( $F=12.275$ ,  $p=0.006$ ) were also significant. Table 2 shows a mean score difference for negative reviews (Mean=4.69, SD=0.55) and positive reviews (Mean=3.91, SD=0.49) was observed ( $F=53.89$ ), which means negative reviews had significantly higher perceived helpfulness than positive reviews. Therefore, H2a was supported. A mean score difference for consistent reviews (Mean=4.05, SD=0.58) and inconsistent reviews (Mean=4.62, SD=0.62) was observed ( $F=45.47$ ), which means inconsistent online clothing reviews had significantly higher perceived helpfulness than consistent online clothing reviews. Therefore, H3a was supported. A mean score difference for concrete reviews (Mean=3.83, SD=0.55) and abstract reviews (Mean=4.68, SD=0.57) was observed ( $F=63.86$ ), which means online clothing reviews with abstract content had significantly higher perceived helpfulness than concrete ones. Thus, H1a was supported.

## CONCLUSION AND DISCUSSION

### Conclusion

Online clothing review has become one of the most influential information sources for purchase behaviour regarding apparel products. A growing stream of literature investigates the factors explaining the helpfulness of online reviews. Adding to previous research, our study aimed to understand the impact of online clothing review concreteness, online clothing review variance and online clothing review valence on individual's perceived review helpfulness. To achieve the research goals, an experimentally designed survey was conducted on real potential online clothing shoppers in China. Results indicate that online clothing review concreteness, online clothing review variance and online clothing review valence are significant factors affecting review helpfulness. This study's findings show that abstract review, negatively review and inconsistent review has a stronger effect on online clothing review helpfulness than a concrete review, positively review and consistent review. Additionally, given the nature of online reviews, consumers are exposed to different online cues at the same time.

Two-way interaction effect of online clothing review concreteness and online clothing review valence on the helpfulness of online clothing reviews was confirmed. Two-way interaction effect of online clothing review valence and review variance on the helpfulness of online clothing reviews was also confirmed. This outcome suggests that the effect of the online clothing review concreteness on the helpfulness of clothing online reviews is moderated by online clothing review valence; the effect of the online clothing review valence on the helpfulness of clothing online reviews is moderated by online clothing review variance.

### Implications

This study contributes to the research on online reviews, has a number of theoretical and managerial contributions. To our knowledge, this research is the first to introduce and systematically examine the role of online clothing review concreteness, online clothing review variance and online clothing review valence in enhancing online clothing review helpfulness.

Our findings contribute to the decision-making literature in several ways. It enriches our understanding of attributes that affect online clothing review helpfulness. From a theoretical point of view, our results in the context of the clothing industry are new as no previous research has investigated the influence of content cues on clothing products in the predicting online review helpfulness process. A new product category not only enriches the sample variety but is also necessary to enable the generalization of suggested theories.

The variance, concreteness, and valence of the information provided in online reviews should be leveraged by marketing managers to improve the overall quality of the information hosted on their websites. Marketers can adopt the content criteria identified in this study as guidelines for review submissions. By utilizing more helpfully online reviews, clothing company are likely to be more effective in their online marketing campaigns; online clothing review writers are able to write more helpful or attractive reviews.

The empirical result of the current research, specifically the superiority of abstract reviews, can serve as new guidance for clothing firms' online review marketing strategies. According to the study, most potential consumers perceive the value of abstract reviews

to be higher. Thus, it is assumed that abstract reviews that include experiential information are practically important in influencing consumers. Online clothing reviews with long, objective information may be found to be unattractive because they are unlikely to be considered actual buyers' comments due to the absence of sympathetic information.

Due to the helpfulness of negative online review, Clothing retailer must pay close attention to negative reviews and respond promptly by providing timely and sincere service recoveries. Thus, the clothing retailer should create standard procedures and protocols in responding to negative reviews to ensure that responses are personally tailored to address review contents.

### Limitations

Despite the theoretical and practical implications, there are several limitations to this research. For example, this research survey was based on a hypothetical situation and, therefore, the intrinsic difficulty in controlling the exogenous factors affecting an

experimental method could not be avoided. Despite the improved internal validity compared with that of the previous studies, this study's results were drawn from experiments and may be detached from a practical situation. Furthermore, the empirical findings are based on clothing products, which are different from common consumer goods. Since research suggests that product type may play an essential role in determining the perceived helpfulness of online reviews, replicating the study with other products or product types may reveal additional insight. Therefore, replication studies in different contexts are necessary to enable the generalizability of our findings and further explore potential differences among various product categories. Future researchers may identify other antecedents of online clothing review helpfulness, such as reviewer characteristics. Moreover, the study gets data from lab experiments, and the sample size is relatively small. Actual review data from online platforms would be helpful in strengthening the findings of the study.

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# Investigating financial opportunities for traditional clothing industry in South Asia based on an analysis of internationally diversified portfolio using ARCH and GARCH models

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## ABSTRACT – REZUMAT

### Investigating financial opportunities for traditional clothing industry in South Asia based on an analysis of internationally diversified portfolio using ARCH and GARCH models

*This paper investigates the benefits of forming an internationally diversified portfolio in the stock markets of Bangladesh, India and Pakistan using the stock market indices data from April 2013 to March 2020. The portfolio comprises of three stock market indices from Pakistan, India and Bangladesh. The goal is to identify financial opportunities for traditional clothing industry in South Asia. Bangladesh, India and Pakistan are neighbouring countries in South Asia. Tradition, culture and specific ethnic elements influence traditional clothing in the case of the selected country cluster consisting of Bangladesh, India and Pakistan. Our empirical results indicate that internationally diversified portfolio does not reduce the risk due to global market integration in the background. Furthermore, ARCH and GARCH models reveal that large change in conditional variance is followed by large changes in conditional variance whereas small change in conditional variance is followed by small changes in conditional variance.*

**Keywords:** traditional clothing, textile industry, portfolio diversification, South Asia, financial opportunities, stock markets

### Investigarea oportunităților financiare pentru industria de îmbrăcăminte tradițională din Asia de Sud pe baza unei analize a portofoliului internațional diversificat aplicând modelele ARCH și GARCH

*Acest articol de cercetare investighează beneficiile unui portofoliu internațional diversificat privind piețele bursiere din Bangladesh, India și Pakistan folosind datele colectate ale indicilor bursieri selectați din aprilie 2013 până în martie 2020. Portofoliul cuprinde trei indici bursieri din Pakistan, India și Bangladesh. Obiectivul este identificarea oportunităților financiare pentru industria de îmbrăcăminte tradițională din Asia de Sud. Bangladesh, India și Pakistan sunt țări vecine din Asia de Sud. Tradiția, cultura și elementele etnice specifice influențează îmbrăcăminte tradițională în cazul clusterului de țări selectat format din Bangladesh, India și Pakistan. Rezultatele noastre empirice indică faptul că portofoliul diversificat la nivel internațional nu reduce riscul din cauza integrării pieței globale. În plus, modelele ARCH și GARCH arată că schimbările ample ale varianței condiționate sunt urmate de modificări semnificative ale varianței condiționate, în timp ce o modificare nesemnificativă a varianței condiționate este urmată de modificări reduse ale varianței condiționate.*

**Cuvinte-cheie:** îmbrăcăminte tradițională, industria textilă, diversificarea portofoliului, Asia de Sud, oportunități financiare, piețe bursiere

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## INTRODUCTION

India, Bangladesh and Pakistan are closely interconnected based on various elements such as nearly identical cultural heritage, traditions, linguistic values, ethnicity, geographical location, natural resources, climate, large population, traditional clothing, but also a high level of poverty. British India split in 1947 into Pakistan and India, while in 1971 due to the conflict between East Pakistan and West Pakistan, a new country emerged. In other words, India helped East Pakistan to maintain its independence as a separate state called Bangladesh. Our cluster includes three representative countries from South Asia, namely Bangladesh, India and Pakistan. Traditional clothing industry plays a very important role in the case of these neighbouring countries. Zhang et al. [1] high-

lighted the fact that clothing manufacturing is rather dependent on significant institutional support in order to cope with new modern technologies. Kim [2] argued that textiles and clothing industry is a traditional sector in India with a major significance for its contributions to total exports, industrial production, and employment. Taneja et al. [3] suggested that India and Pakistan represent the leading textile trading countries worldwide, considering that bilateral trade is better well-marked in textiles compared with clothing, while cotton yarn represents the most traded textile product. Ahmed et al. [4] highlighted the fact that the fashion industry in Bangladesh includes two main components, respectively traditional clothing and modern Western apparels. Currently, clothing can be produced using performance tools like pattern design

software, 3D scanning for anthropometric data acquisition and 2D/3D simulation, modelling and fitting software [5]. In a critical manner, Bernardes et al. [6] mentioned that most consumers claim that they are interested in sustainability aspects but still purchase "cheap" fashion. Considering all these challenges, can financial market dynamics provide growth opportunities for traditional clothing industry in South Asia, especially in the case India, Bangladesh and Pakistan?

The sub-prime credit crunch escalated in the United States from 2007 to 2008, hence, affected the financial sector of the world and particularly Europe's financial sector. The fall of financial sector has led the whole financial industry deteriorated in many parts of the world and eventually resulted into a global financial crisis 2008. The International Monetary Fund (IMF) declared financial crisis as "*The Great Recession*" that has revealed major flows in our financial system. Dominique Strauss-Kahn, the managing director in IMF, has urged the necessity to develop new global framework that can ascertain the better coordination of national and international policies pertaining to financial system [7]. Hence, national policies should be prepared in a way that should integrate and support international financial policies to avoid another financial crisis. Perhaps, understanding how the financial system works and how it is related to economy will also help us determining the financial policies that strengthen the economic growth. A financial system is an avenue that is a link between excess financial resources possessed by investor and public or private enterprises. This system helps economy grow and enhances the level of investors' consumption capacity. Though investment risk is shared among different parties, but they must face the market volatility. Trivedi et al. highlighted the linkage between investment opportunities and international diversification of the portfolio [8]. The relationship between investors and enterprises forms an overall financial system of the country. This financial system is more robust and efficiently achieves its objective when economy is characterised by political, economic and financial stability [9].

The episodes of increasing financial crisis in recent eras enable us to believe that the flow of capital (investors' saving) directed by the stock markets can lead to a very different dimensions other than being an efficient allocation of saving towards the best investment opportunities. The increasing speed of globalization, sometime, indicates how financial systems fail and drives the whole economy into financial crisis. The higher level of integration of financial markets on a global scale eradicates the opportunities of portfolio diversification. Such integration generates positive correlation among international stock indices returns which compromise the portfolio diversification. When international financial markets collapse, the effect rapidly spreads across emerging stock markets as well [10]. The modern portfolio theory formulated by Markowitz [11] first introduced the mathematical consideration to diversify the portfolio risk, though he

cannot perfectly eliminate the risk. Through diversification method, risk can be reduced without affecting the magnitude of portfolio's expected returns. Thus, low correlated stock indices are the perfect candidates to include into portfolio formation.

Solink [12] along with other researchers, suggested that investment into international stock indices help diversify portfolio risk greater than the investment into domestic stocks but increasing speed of integration of financial markets bring in positive correlation between stock indices and benefits of investment into international stocks are decreasing [13]. Ejaz et al. [14] argued that global investors consider the opportunity of investing in the international financial markets while holding a diversified portfolio and minimizing risk. Based on the above discussion, current study aims to investigate the evolution of portfolio risk based on investment in three international stock indices. Portfolio diversification strategy represents a very important investment tool used to manage stock market risks [15]. For instance, India is a growing emerging economy [16] so has a great potential to attract investment opportunities based on the international portfolio diversification.

## MEASURING THE VOLATILITY OF PORTFOLIO USING ARCH AND GARCH MODELS

Linear estimation techniques (OLS) are incapable of explaining the number of important features that are common to the financial time series.

- *Leptokurtosis* – The likelihood fat tails pertaining to financial time series data.
- *Volatility Clustering* – The tendency to stock returns volatility that appears in clusters on time series financial data. For example – the large returns of stocks, either sign, are followed by large returns and small returns of stock, either sign, are expected to have small returns in the following period. One of the explanations to volatility clustering is that the arrival of information that creates volatility clustering in the stock returns.
- *Leverage effect* – the likelihood of volatility to increase more following the large dip in the prices, compared to the price rise of the magnitude.

According to Compbell, Lo and Mackinlay [17], a non-linear time series is the one where the current value is correlated non-linearly to current as well as previous values of the error term ( $\mu$ ):

$$Y_t = f(\mu_t, \mu_{t-1}, \mu_{t-2}, \dots) \quad (1)$$

where  $\mu_t$  is an independent error term and  $f$  is a non-linear function of dependent variable  $Y_t$ . A more specific form of non-linear model is as follows:

$$Y_t = g(\mu_{t-1}, \mu_{t-2}, \dots) + \mu_t \sigma^2 \mu_{t-1} \mu_{t-2} \quad (2)$$

where  $g$  is the function of previous error term and  $\sigma^2$  is the variance term. The  $g$  is non-linear in mean with non-linear  $\sigma^2$  variance. Any model can be linear in mean and variance (ARMA model) or can be linear in mean and non-linear in variance (GARCH model) [18]. We mostly use non-linear models such as ARCH and GARCH to estimate the volatility in financial data.

### The Autoregressive Conditional Heteroscedasticity Model (ARCH)

Homoscedasticity is one of most important assumptions of classical regression model, for instance, variance of error term is constant over time:  $var(\mu_t) = \sigma^2(\mu_t)$ ,  $\mu_t \sim N(0, \sigma^2)$ . If variance of the error term is not constant over time is called heteroscedasticity which is very likely in financial time series data. Thus, it is important to select the estimator that does not assume the constant state of variance of error term and moreover, it should also ascertain that how error term variance evolves over time.

Another problem with time series financial data is volatility clustering meaning that the period of high volatility is followed by higher volatility period and period of low volatility is characterized with period of lower volatility. Using ARCH model, the time series financial data with non-constant variance in error term can be parameterized. It is also necessary to define a conditional variance of error term  $\mu_t$  in order to understand how ARCH model works. The conditional variance of  $\mu_t$  is represented by  $\sigma^2$  as follows:

$$\begin{aligned} \sigma_t^2 &= var(\mu_t | \mu_{t-1}, \mu_{t-2}, \dots) = \\ &= E[\mu_t - E(\mu_t) | \mu_{t-1}, \mu_{t-2}, \dots] \end{aligned} \quad (3)$$

If  $E(e_t) = 0$ , then equation 3 can be written as:

$$\begin{aligned} \sigma_t^2 &= var(\mu_t | \mu_{t-1}, \mu_{t-2}, \dots) = \\ &= E[E(\mu_t | \mu_{t-1}, \mu_{t-2}, \dots)] \end{aligned} \quad (4)$$

According to equation 4 a conditional variance of zero mean random variable  $\mu_t$  that is normally distributed is equal to the conditional expected value of the square of  $\mu_t$ . In such a situation ARCH model is as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_t^2 \quad (5)$$

Equation 5 is an ARCH (1) model which shows that conditional variance of error term  $\sigma_t^2$  is influenced by its immediate previous square root value. However, it should be noted that equation 5 only ascertains the part of complete model because it does not have anything to say about conditional mean. The conditional mean equation, where dependent variable  $Y_t$  changes over time can take any form under ARCH model. The full ARCH model is as follows.

$$Y_t = \beta_1 + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \mu_t \quad (6)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 \quad (7)$$

where  $\mu_t \sim N(0, \sigma^2)$ .

Equations 6 and 7 can also be expressed in general form where variance of an error term is influenced by  $k$  lags of square errors. This type of model is called ARCH( $k$ ).

$$Y_t = \beta_1 + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \mu_t \quad (8)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \alpha_2 \mu_{t-2}^2 + \dots + \alpha_k \mu_{t-k}^2 \quad (9)$$

where  $\mu_t \sim N(0, \sigma^2)$ .

$\sigma_t^2$  is a conditional variance where it has positive value (a negative variance at any time is meaningless), which means that the variance regression must produce positive coefficients, for instance  $\alpha_i \geq 0$ ,  $(\forall) i = 0, 1, 2, \dots, k$ . GARCH is the extension of ARCH( $k$ ) model.

### The Generalized Introgressive Conditional Heteroscedastic Model (GARCH)

The GARCH model, developed by Bollerslev [19] and Taylor [20] estimates conditional variance that is influenced by its only previous lagged values.

Following equation is an example of conditional variance.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta \sigma_{t-1}^2 \quad (10)$$

Equation 10 is a GARCH(1/1) model where  $\alpha_1 \mu_{t-1}^2$  express the information of volatility pertaining to previous period and variance during that period  $\beta \sigma_{t-1}^2$ . GARCH (1/1) model can also be written in a GARCH ( $k, p$ ) form where conditional variance is influenced by  $k$  lags of squared errors and  $p$  lags of conditional variances.

$$\begin{aligned} \sigma_t^2 &= \alpha_0 + \alpha_1 \mu_{t-1}^2 + \alpha_2 \mu_{t-2}^2 + \dots + \alpha_k \mu_{t-k}^2 + \\ &+ \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_{t-2}^2 + \dots + \beta_p \sigma_{t-p}^2 \end{aligned} \quad (11)$$

Equation 11 can be rearranged as:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^k \alpha_i \mu_{t-i}^2 + \sum_{j=1}^p \beta_j \sigma_{t-j}^2 \quad (12)$$

GARCH (1/1) model is mostly estimated and sufficient to estimate the evolution of volatility as GARCH (1/1) model is as good as ARCH (2) and GARCH ( $k, p$ ) is as good as ARCH ( $k + p$ ) model [21]. Moreover, GARCH models are conditionally heteroskedastic, while are characterized by constant unconditional variance [22].

On the other hand, it is important to highlight the fact that emerging stock markets are distinguished by certain characteristic features such as: "systemic vulnerability, lofty volatility, embryonic trading mechanisms, problems related to financial regulation, non-liquidity, inadequate transparency, challenging task to access all information that are available, meagre volume trading, opportunities of diversification, different risk categories and unpredictable situations" [23].

### EMPIRICAL RESULTS AND DISCUSSION

This section interprets the empirical results and provides insight into the estimations using ARCH and GARCH models.

#### Data and descriptive statistics

Our sample data includes three indices namely KSE 100 index (Pakistan stock market), BSE SENSEX 30 (BSESN) (Mumbai stock market, India) and DSEX (Dhaka stock market, Bangladesh) from April 2013 to March 2020 with 1726 observations. The selection of these market indices is based on the Pearson correlation that indicates lowest correlation among these three indices (table 1).

Table 1

PEARSON CORRELATION			
Index	KSE 100 index	SENSEX 30 (BSESN)	DSEX
KSE 100 index	1.000	-	-
SENSEX 30 (BSESN)	0.0176	1.000	-
DSEX	0.0185	0.0055	1.000

Despite table 1 indicates lower correlation among three indices, but, Aloui [13] ascertained in his paper that correlation coefficient may not be the best indicator of financial market independence. He further states that the correlation coefficient cannot distinguish between positive (negative) and large (small) stock returns. Furthermore, Pearson correlation coefficient is calculated based upon the assumption of linear association shipping time series financial data, whereas their linkages may also take the non-linear causality forms. This problem can be resolved through transforming the data into log form which can also be applied on non-linear model. Another way to resolve this problem is to use GARCH model.

We compute the returns of these three indices through following formula:

$$r_{it} = \ln \left( \frac{p_{it}}{p_{it-1}} \right) \times 100 \quad (13)$$

where  $r_{it}$  is the compounded returns of stock  $i$  at time  $t$ ,  $p_{it}$  is current prices of stock  $i$  in  $t$  time and  $p_{it-1}$  is previous year prices of stock  $i$  in  $t$  time. Our portfolio weights composition is 50% stock from KSE 100, 25% from SENSEX 30 (BSESN) and 25% from DSEX. We also adopted passive portfolio approach. Table 2 shows the descriptive statistics of all three indices and portfolio. The highest returns are associated to Mumbai stock market whereas the lowest

Table 2

DESCRIPTIVE STATISTICS OF DAILY INDICES RETURNS				
Indicator	KSE 100 index	SENSEX 30 (BSESN)	DSEX	Portfolio
Mean	-0.0165	-0.0188	0.0016	-0.0125
Standard Deviation	1.0690	1.0499	0.8958	0.6440
Max	7.3607	14.7851	6.7370	5.2409
Min	-4.3224	-5.3139	-9.7984	-2.6584
Observation	1726	1726	1726	1726

returns are pertaining to Dhaka stock market. However, Dhaka stock returns are less riskier than Karachi and Mumbai stock markets. The formation of portfolio based on these three indices make portfolio less risky, however, the returns are still negative due to Karachi and Mumbai negative stock returns.

Figure 1 shows the volatility of three indices and portfolio constructed based on these indices from April 2013 to March 2020. The graph 1 indicates that returns are stable over the course of sample period; however, they are subject to volatility clustering and leverage effect. For instance, KSE 100 index contain volatility clustering on April 2013, January 2016, January 2019 and January 2020. Similarly, SENSEX 30 (BSESN) is subject to volatility clustering on April 2013, January 2018 and January 2020. However, DSEX shows volatility clustering on April 2013 and January 2020. On the other hand, portfolio returns are also subject to volatility clustering April 2013, January 2016, January 2018 and January 2020. Figure 1 confirms the existence of volatility clustering in our sample indices and portfolio returns. The next step is to check whether our residuals of portfolio return contain any ARCH effect.

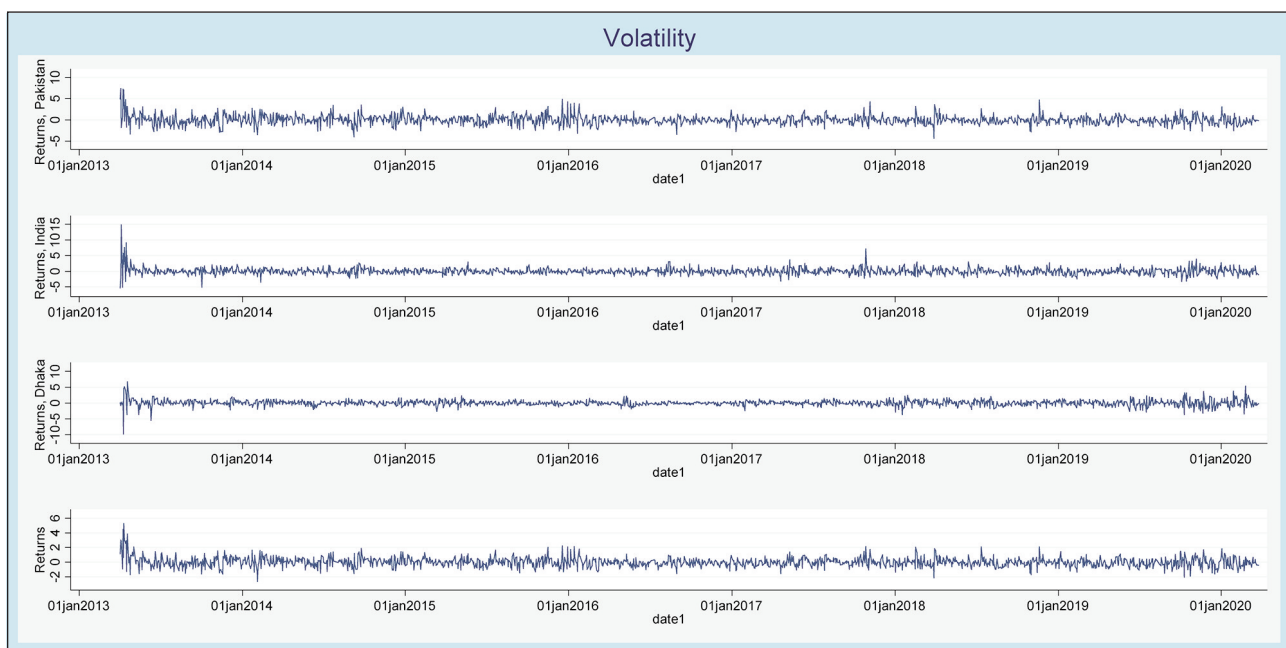


Fig. 1. Volatility of Daily Indices Returns



Table 3

LM TEST FOR ARCH EFFECT IN THE RESIDUALS			
Lags (p)	Chi2	Df	Prob > Chi2
1	87.919	1	0.0000

Table 3 shows the results of LM test for ARCH model with lag (1). LM test has null hypothesis i.e. ( $H_0$ ) "no ARCH effect in the residuals" and alternative ( $H_1$ ) "ARCH(p) disturbance in the residuals". The LM test produces p-value which is less than 0.05 which rejects the  $H_0$  and accepts  $H_1$  that establishes the residuals of portfolio returns contain volatility clustering and subject of ARCH effect.

#### Estimation results of ARCH and GARCH model

Table 4 shows ARCH (1/1) and GARCH (1/1) results using ARCH method. The ARCH and GARCH model show the internal effect of time series of portfolio returns. The coefficients of squared errors and conditional variance are statistically significant at 5% and 1% level of significance, respectively. The coefficient of ARCH model is significant at 1% level that means that previous day's information pertaining to portfolio

Table 4

MEAN MODEL AND VARIANCE MODEL OF ARCH AND GARCH		
VARIABLES	(1)	(2)
	Portfolio	ARCH
Portfolio (Mean Model)		
Constant	-0.0294** (0.0358)	-
Variance Model		
Constant	-	0.0094 (0.7625)
L. ARCH	-	0.1927*** (0.0000)
L. GARCH	-	0.7847*** (0.0000)
Observations	1,726	1,726

Note: pval in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 5

CORRELOGRAM				
LAG	AC	PAC	Q	Prob>Q
1	0.2216	0.2216	84.877	0
2	0.1027	0.0575	103.13	0
3	0.0935	0.0645	118.27	0
4	0.0995	0.0654	135.42	0
5	0.1305	0.0957	164.92	0
6	0.0979	0.0435	181.55	0
7	0.0524	0.0112	186.33	0
8	0.004	-0.0277	186.35	0
9	0.0179	0.0061	186.91	0
10	0.0502	0.0354	191.29	0

Table 6

HETEROSKEDASTICITY TEST: ARCH			
Lags (p)	Chi2	Df	Prob > Chi2
5	0.000	5	1.000

returns can greatly influence the current portfolio returns. Similarly, GARCH model coefficient is significant at 1% level that means previous days volatility of portfolio returns greatly affect the present day's volatility of portfolio returns. Hence, table 4 shows period of high volatility is followed by period of higher volatility and period of small volatilities are also followed by period of smaller volatility.

To validate the result of table 4 we run the correlogram of squared error and ARCH test. The correlogram included in table 5 provides evidence that square error do not contain ARCH effect further which can also be confirmed through ARCH test in table 6.

#### CONCLUSIONS

It is important in the realm of financial markets to study and investigate the volatility of stock returns in a time series data as well as in the context of cross market correlations. Volatility and cross market correlation have profound implications about flow of capital or capital allocation. As, in first glance, table 1 indicates the lower level of correlation among aforementioned three indices, seemingly, portfolio formation based on these indices is a better opportunity to allocate our saving because according to the Pearson correlation Pakistan (KSE 100 index), India (SENSEX 30) and Bangladesh (DSEX) are not highly correlated and their movement are not tandem. However, our overall results reveal that international diversification does not reduce the portfolio risk. One plausible reason is the higher global integration of financial markets.

We also evaluated the internal effect of time series portfolio returns using ARCH and GARCH model in the context of international diversification. The weightage composition of portfolio formation is 50% from KSE 100 index, 52% from SENSEX 30 index and 52% from DSEX index. We applied Engle (1982) test on portfolio returns to track any ARCH effect in the time series. Volatility clustering effect can also be observed through graph 1 based on portfolio returns. The volatility is persistent in April 2013, January 2016, January 2018 and January 2020. Taking ARCH effect into consideration, we were able to estimate the GARCH (1/1) model. The GARCH lag 1 coefficient (almost 0.79) is highly significant which indicates that conditional variance is subject to volatility and conditional variance shocks are persistent in the time series data. In other words, a large change in conditional variance is followed the period of large changes in conditional variance whereas small changes in conditional variance is followed the small changes in conditional variance.

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# Research on the origin of clothing from the perspective of the ancient Chinese character etymology and philosophy

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## ABSTRACT – REZUMAT

### Research on the origin of clothing from the perspective of the ancient Chinese character etymology and philosophy

*The origin of clothing has always been one of the most important topics in the field of apparel culture research. However, academics have different opinions on this issue. Based on the dilemma analysis of the three research routes which include philology, archaeology, anthropology, we can study the essence of the origin of clothing by analysing ancient Chinese character and philosophy. The relative methods of characters etymology in ancient China, archaeology, anthropology and philosophy are adopted in this study in order to further study the origin of clothing. The research shows that: from etymology research on characters in ancient China, Chinese characters associated with clothing can reflect the objective needs of clothing-the carrying tools whose material are cortex. From the perspective of philosophical researches, clothing prototype originated in the cortical belt for carrying in the process of human evolution during the Palaeolithic. It is an important tool for primitive humans to increase their survival rate. And formed clothing is necessary for them to get out of the Africa and expand their living space. First of all, this paper systematically demonstrates the idea that clothing originated from tools based on the analysis of ancient Chinese characters. Secondly, from the perspective of philosophy, this paper demonstrates the great historical role of clothing as a survival tool, based on the viewpoint that the generation of clothing precedes the consciousness of clothing.*

**Keywords:** clothing, evolution, tools, origin, Oracle

### Cercetări privind originea îmbrăcămintei din perspectiva etimologiei și filosofiei antice chineze

*Originea îmbrăcămintei a reprezentat întotdeauna unul dintre cele mai importante subiecte în domeniul cercetării culturii îmbrăcămintei. Cu toate acestea, cadrele universitare au opinii diferite cu privire la această problemă. Pe baza analizei dilemei celor trei rute de cercetare care includ filologia, arheologia și antropologia, putem studia esența originii îmbrăcămintei prin analiza caracterului și filosofiei antice chineze. Metodele relative ale etimologiei caracterelor din China antică, arheologia, antropologia și filozofia sunt adoptate în acest studiu pentru a studia originea îmbrăcămintei. Cercetarea arată că: din cercetările etimologice asupra caracterelor din China antică, caracterele chinezești asociate cu îmbrăcămintea pot reflecta nevoile obiective ale îmbrăcămintei - instrumentele de transport al căror material este cortexul. Din perspectiva cercetărilor filozofice, prototipul vestimentar își are originea în centura corticală pentru purtare în procesul de evoluție umană din timpul paleoliticului. Este un instrument important pentru oamenii primitivi pentru a-și crește rata de supraviețuire, iar îmbrăcămintea este necesară pentru ca ei să părăsească Africa și să-și extindă spațiul de locuit. În primul rând, această lucrare demonstrează sistematic ideea că îmbrăcămintea provine din instrumente bazate pe analiza caracterelor antice chineze. În al doilea rând, din perspectiva filozofiei, această lucrare demonstrează marele rol istoric al îmbrăcămintei ca instrument de supraviețuire, pornind de la punctul de vedere că generarea îmbrăcămintei precede conștiința îmbrăcămintei.*

**Cuvinte-cheie:** îmbrăcămintă, evoluție, unelte, origine, Oracol

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## INTRODUCTION

There are more than ten academic viewpoints on the origin of clothing. The representative ones are Body Protection Theory, Theory of Warm-keeping, Sexual Attraction Theory, Shame Theory, Decorative Theory, etc. However, there are historical explanations on the basis of the version of Whig in the researches. In fact, clothing research is just a sub-path in many human evolutionary routes, which is a tool and means of human evolution to a more civilized stage. In recent years, Bernard's view [1] that "clothing originated

from carrying tools" has begun to attract the attention of the many researchers. Since Bernard simply proposed this point, Tao Yuan et al. [2] demonstrated the origin of clothing as a tool by analysing the source of ancient Chinese characters and using the speculative deduction method combined with facts. Ancient Chinese characters refer to the Chinese characters used from Shang to Qin dynasties, mainly including Oracle, bone inscriptions and seal characters. Chinese characters, as pictographic and ideographic characters, basically preserved the pictographic features [3]. From the very beginning, pictographic

characters have already contained symbolic meanings that transcend analogue objects. It is this aspect that makes pictographs of Chinese characters different from paintings in essence, being of unique abstract meanings value and function of symbols [4]. Therefore, pictographs of ancient Chinese characters can reflect the fundamental intention of the character-building, and can also restore the original of the things described at the beginning of the character creation. Based on the analysis of the dilemma of the conventional route of clothing origin, this paper initiated and conducted in-depth research on the viewpoint that clothing originated from leather belt.

### **THE DILEMMA OF THE CONVENTIONAL RESEARCH ROUTE OF CLOTHING ORIGIN**

The conventional research route of clothing origin mainly includes three research aspects: philology, archaeology and anthropology. However, because clothing originated from the beginning of human evolution, it belongs to the category of prehistoric civilization, which is far away from the modern time, resulting in contradictory views on documents and serious lack of cultural relics in archaeological research. Anthropology, on the other hand, studies the language, behaviour and social attributes of modern "primitive man" and then makes a reverse extrapolation of the living state of the real primitive man. Therefore, these three research aspects all have their own research dilemmas.

#### **The dilemma of conflicting viewpoints in philology**

Philology refers to the study of reading, collecting, organizing, researching and utilizing ancient literature. China still maintains vast ancient literature, including a large number of records of human life in ancient times. Summarizing the literature related to the origin of clothing, it is found that these ancient documents mainly include the viewpoint of the protection of clothing origin. There are quite a few ancient Chinese Confucian and Taoist documents that hold the view of clothing origin protection. The Chinese Dictionary *Shi Ming* written by Liu Xi, a scholar of Han Dynasty, pointed out: "The main function of garments is the tools that people use to keep warm and prevent heat". Chuang Tzu stated that "Human beings had no clothes at the beginning. They collected combustible materials in summer and burned them to keep warm in winter. In the time of Yan Emperor, it was still in the matriarchal society, and people had begun farming and weaving clothes" [5]. However, Confucianism and Taoism have different concepts about clothing: *Shi Ming* believes that clothing is used to avoid the heat and cold, but does not clearly point out that the material of the clothing must be textile fabrics; and Chuang Tzu's *Chuang Tzu* clearly points out those only woven clothes.

In addition, with regard to the time of the origin of clothing, the views of Confucianism and Taoism are quite different. According to The book of Rites regarded as

a classic by Confucian, "At first, humans could not build houses, lived in caves in winter, in summer they built nests on trees like birds. They did not know how to use fire, and they ate the fruits of plants and meat of animals. They lived a very primitive life. At the same time, there was no textile technology, only the feathers and furs of birds and animals could be used as clothes" [6]. Therefore, Confucian scholars believed that clothing had appeared before the ancestors used fire, however humans have been using fire for 500,000 years or more [7]. On the contrary, according to *Chuang Tzu*, clothing originated from the era of the Yan Emperor, after the ancestors used the fire, which was about 5,000 years ago. Since origin of clothing happened in the ancient times, there are contradictory views on the origin of clothing from the perspective of philology.

In fact, there are still some problems in using the ancient literature to study the origin of clothing. Firstly, the date of the appearance of these ancient documents needs to be verified to determine the minimum age of their views. For example, the records on the origin of clothing in *The Book of Rites* can only reflect a view on the origin of clothing in the time when *The Book of Rites* was written because the ancients looked at the origin of clothing with the "Whig" view of history. Secondly, the authenticity and edition of ancient documents need to be ascertained. On the one hand, although there are many ancient Chinese documents, they are also mixed with some fake books, which were written by ancient people in the guise of ancient celebrities [8]. On the other hand, the issue of the version of Chinese ancient literature is also a big problem. Ancient Chinese documents have been circulating for a long time. Different versions have been produced due to the problems of copying, printing, recompiling, adding and deleting. Therefore, the earliest version of the records concerning the origin of clothing needs to be determined so as to obtain accurate information.

#### **The dilemma of the serious lack of cultural relics in archaeological research**

Because the fabric is extremely perishable, it is obviously unrealistic to find the earliest Chinese clothing. However, the bone needles for making garments can be turned into fossils and preserved for a long time. Therefore, the discovery of bone needles is of great significance for studying the lower limit of the origin of clothing. According to the current archaeological findings in China, bone needles have appeared in the late Palaeolithic age in China, indicating that the origin of Chinese clothing should be no later than the late Palaeolithic age. For example, in 1930, the earliest bone needle in China was found in the ruins of the Upper Cave Man at Longgu Mountain in Zhoukoudian, Fangshan District, and suburb of Beijing (figure 1). The bone needle is 8.2 cm long, only the thickness of the match stick, the needle body is slightly curved, and the scraping is smooth. One end of the bone

needle is a sharp tip, and the other end is a needle eye made of extremely sharp objects. Although the needle eye was damaged when it was found, it is not difficult to see its original appearance. The discovery of bone needles proved that the Upper Cave Man had the ability to sew clothes and was no longer naked [9]. According to the C14 test of the animal bones unearthed at the same time, the age of the Upper Cave Man should be about 11,000 years ago [10]. That is to say, the origin of Chinese clothing should be far earlier than 11,000 years ago.



Fig. 1. The bone needle of Upper Cave Man

In addition, bone needles are not seen in the site of primitive men in China, which is older than Upper Cave Man, but that doesn't show the primitive people didn't have clothing. Archaeological methods can hereby only determine the lower limit of the time of clothing origin, but cannot research further, because the original clothing was probably the animal skin on the body and did not need to be stitched with a needle.

### The dilemma of over-generalization in anthropological research

Anthropology and ethnography have accumulated a large amount of materials for the clothing of modern "primitive society". From these materials, it seems that most of them can provide some reasonable evidence for the theory of aesthetic origin and identifi-

cation of clothing. Anthropology research route is usually aimed at the clothing behaviour of "primitive people" in some existing primitive tribes. However, there are some inborn defects in this research route. First of all, what anthropology studies are not the primitive people of prehistoric times? It is the modern "primitive man". These "primitive people" may retain the thinking characteristics of some primitive people in prehistoric times. But there is environment difference between the two. Therefore, motives in use of the modern "primitive" clothing and the prehistoric primitives' clothing cannot match. Secondly, the development of modern "primitive people" is far from reaching the state of civilization, and their living environment is relatively closed and single, which can only be considered as one of the choices in the process of human civilization. Naked modern "primitive man" may be unable to start the civilization process because of lack of stimulation of clothing motivation.

### THE ANALYSIS ON ETYMOLOGY OF ANCIENT CHINESE CHARACTER

#### The original clothing is the carrying tool

From the analysis on the source of Chinese ancient characters, there is a close relationship between the origin of clothing and tools. In accordance with the viewpoints and argumentation methods of Tao Yuan and Yu Weidong that clothing are used as containers for carrying goods, some ancient Chinese characters (table 1) related to clothes are classified in detail. As shown in table 1, in oracle bone inscriptions, the word "Yi (clothing)" in Chinese characters is very similar to the object composed of two curved sheets. In the meantime, when it is used as etymon, all have the meaning of wrappage.

#### The original clothing was made of leather

The ancient Chinese character "Yi (clothing)" can not only suggest that clothes originated from tools, but also reflect materials of the most primitive clothing. It can be seen from table 2 that some ancient Chinese characters related to the original clothing materials,

Table 1














AUXILIARY CLOTHING ORIGINATED IN THE TOOL PART OF THE ANCIENT CHINESE WORD SOURCE ANALYSIS TABLE			
Modern Chinese characters	Word origin	Glyph decomposition	The original meaning of Chinese characters
衣	 (Oracle)	宀 and 彡	The container for holding things composed of two curved sheets
裹	 (Seal character)	宀 (clothing) and 果 (fruit)	The ancients used clothes to pack wild fruits from the mountains
装	 (Seal character)	壯 (man) and 宀 (clothing)	Ancient man picked for the long journey
奋	 (Bronze inscriptions)	宀 (clothing) and 彡 (bird) and 田 (field)	Using clothing to capture birds in the field

Table 2

ANALYSIS TABLE ON SOURCE OF THE ANCIENT CHINESE CHARACTER REFLECTING THE ORIGINAL CLOTHING MATERIALS			
Modern Chinese characters	Word origin	Glyph decomposition	The original meaning of Chinese characters
裘 (Qiu)	 (Oracle)	 (clothing) and  (fur)	Fur coat
衰 (Shuai)	 (Seal character)	 (clothing) and  (a large number of palm fibre that are drooping down)	The ancients connected the palm leaves of the fibre down to “palm-woven rain-cloak”
褐 (He)	 (Seal character)	 (clothing) and  (vine)	Ragged clothes made from kudzu and hemp

and fabrics of the most original clothing must be made of leather. As can be reflected by The Oracle “Qiu (fur coat)” and the seal character “He (coarse clothing)”. On the one hand, from the glyph of the word “Qiu” in Oracle, it is like a coat covered with fur. Then, the clothing must be leather at first. Seal character “Shuai (the weeds made of burlap in ancient times)” is clothing made of brown fur. On the other hand, the seal character “He (coarse clothes)” reflects the “clothing” made from rattan plant fabrics such as kudzu and hemp. If the initial material of clothing is plant fibre like kudzu and hemp, then the pictograph of “He (coarse clothes)” should be the initial shape of ancient Chinese character “Yi (clothing)”, however that was not the case. Therefore, there is no doubt that at least the material of the original clothing in China should be made of leather.

#### The original clothing is made of leather belt

The shape and structure of the original clothing has always been a controversial topic in the field of clothing history. In fact, Oracle can also provide us with key clues. The shape of the original clothing should be a leather belt, as was evidenced by the oracle “Jin (Small piece of textile)” and “Dai (belt)” (table 3). First of all, from the oracle’s pictograph of “Jin”, it is very similar to the fig leaf that blocks the front crotch. The accessories of ancient Chinese clothing “Bixi” (a kind of clothing used by both men and women in the

ancient Central Plains, covering the thighs to the knees) should be its remains, but the width of “Bixi” becomes very narrow and only exists for decoration. Secondly, judging from the pictograph of the oracle bone inscriptions “Dai”, the word “Dai (belt)” is a long, flat strap worn around the waist to fasten a skirt.








#### PHILOSOPHICAL ANALYSIS

##### The essence of clothing

There are three dimensions to understand the essence of clothing. One is to regard clothing as the need of human survival and development, which came into being when human society developed to a certain social stage. Thus, it can be revealed that the origin of clothing is the result of existence determining consciousness. Second, clothing is seen as the requirement of human aesthetic art, which appeared as an aesthetic object when it entered the society, it was concluded that the origin of clothing was the result of aesthetic consciousness. Third, clothing is regarded as the psychological needs of human beings, whose origin is to meet the psychological needs of individual differences of human beings, which ultimately leads to the conclusion that consciousness determines the existence.

According to Abraham Harold Maslow’s hierarchy of needs (AD 1908–1970), human needs are physiological needs, safety needs, social needs, respect needs and self-actualization needs from low to high.

Table 3

ANALYSIS TABLE OF SOME ANCIENT CHINESE CHARACTER SOURCE RELATED TO THE SHAPE AND STRUCTURE OF THE ORIGINAL CLOTHING			
Modern Chinese characters	Word origin	Glyph decomposition	The original meaning of Chinese characters
巾 (jin)	 (Oracle)	 (belt) and  (a piece of sagging fabric)	A fig leaf covering the front of the crotch
带 (dai)	 (Oracle)	 (fig leaf) and  (a cloth covering the hip) and  (a knotted belt between the fig leaf and the cloth covering the hip)	A long, flat strap worn around the waist to fasten a skirt

There is no doubt that primitive humans lived a precarious life, and the satisfaction of their physical needs must be their first priority. The leather belt and the rudiment of clothing both played a crucial role as an effective tool to improve the efficiency of food acquisition. In fact, from the order of the ancient Chinese people's "clothing, food, housing and transportation", it can be seen that "clothing" is of the key status in the minds of Chinese ancients, because "clothing" was once the most important survival tool for the hominids. First of all, "clothing" is a tool for survival and development, being very logical for "clothing" to be ranked before "food". Without the existence of such an important tool as "clothing", there would be no reliable guarantee for the acquisition of "food". Secondly, when people solve the problem of "food", then solve the problem of security - "housing" is hereby taken for granted. Finally, when the security problem is solved, human's means of expanding and developing the space - "transportation" is highlighted. Apparently, the explanation of the sequence of "food, clothing, housing and transportation" fully conforms to Maslow's hierarchy of needs and Marx's theory that "production material is life itself". Therefore, based on the order of "clothing, food, housing and transportation", clothing must be an important survival tool in the process of human evolution.

#### **The conditions under which primitive man had clothing**

When discussing the conditions under which primitive man had clothing, it is generally acknowledged that the conditions were depended on clothing material, manufacturing processes and motivation. First of all, from the perspective of the clothing materials, the academic community generally believes that leather clothing is used in the cold northern regions, while "huifu" is used in the warm southern regions. However, from the perspective of the etymology of ancient Chinese characters, as the main body of farming civilization, Han nationality's original clothing material was leather. With the invention of plant fibre technology, the main body of its clothing material was transformed from leather into plant fibre products. At the same time, the use of the leaves as a cover or decoration of the body is not a real clothing. On the one hand, if the leaves are not preserved for a long time without a certain process, they cannot be used as an appendage of the body; on the other hand, the body cover made by the vine leaves cannot show the identity and status of the individual compared with the fur. In East Africa, for example, the chief wears an armband and a foot ring made of a giraffe's tail to distinguish him from other members [11]. It can be seen that as the eastern part of the tropics, the temperature is hot, but the animal's fur logo is used instead of the vine leaves when the leader status is displayed. Secondly, from the point of view of the manufacturing process of clothing, the bone needle can be used as a key tool. Bone needles, however, can only be used for fur or fabric instead of foliage. The use of fur in clothing is much earlier than the use of plant fibre

fabrics, the origin of the clothing technology is obvious for the use of fur. Finally, from the relationship between dressing facts and dressing motives, the production of clothing objects is much earlier than the dressing motive. Therefore, the dressing motive cannot be used to reasonably explain the origin of clothing; the explanation is also a Whig explanation.

#### **The purpose of primitive dressing**

The purpose of primitive dressing is not its motivation but its value. According to Darwin's Theory of Evolution, humans have evolved from ape-man, being covered with hair. Meanwhile, the application of modern molecular biology in anthropology continues to strengthen the argument that modern humans originated from Africa and spread to other regions. Through the analysis of genetic variation in high-flux populations, we can further infer the time of early modern people going out of Africa and reaching nodes around the world [12]. It was only about 1.8 million to 2 million years ago that humanity left Africa and spread rapidly in Eurasia [13]. Africa is located in tropical and subtropical areas, which account for more than 95% of the total area. Even in the Quaternary (3 million years ago) when humans were born, there was no cold climate. Therefore, hominids did not have the need to protect themselves from the cold. The value of clothing can only be seen in the process of human evolution. Engels once pointed out that labour created the people themselves, but labour also created human clothing. The primitive leather belt of the clothing has played an active role in the evolution of human beings, and the formed clothing is necessary means for humans to expand their living space.

#### **The important role of the original leather belt from the perspective of human evolution**

The leather belt has always been playing a positive role in human evolution. No matter what kind of civilization or culture, whether it is a highly developed ancient civilization or a "modern primitive man" in a naked state, there are many differences in clothing, possessing a belt is their common feature. Therefore, it is reasonable to look at the role that the leather belt has played, and to stand in the perspective of human evolution and make reasonable inferences.

First, hair removal is the first step in human evolution. Humans belong to omnivorous primates, and meat plays a key role in the evolution of human beings. In order to effectively capture the prey, continuous running has become the initial magic weapon for human beings. In the meantime, continuous running requires a fundamental change in the heat dissipation mechanism of humans. Humans gradually got accustomed to using the skin for effective heat dissipation, becoming the only animal in all terrestrial mammalian to use the whole body skin for heat dissipation. Thus, human beings appear on the African savanna in a naked image.

Secondly, tool manufacturing is a sign that humans are different from other animals. However, the tools

used need carrying. The tools for hunting includes not only stone spears, slings, etc., but also stone knives, wooden knives, and bone knives used to cut animal carcass. Therefore, effective methods are needed to carry tools for cutting animal carcasses. There are two ways to carry the tools. One is to tie the tools to the body in series by means of a linear soft substance. The other is to use sheet-like soft material to directly wrap and tie it around the waist [2]. Both of the ways of carrying tools can be found in traditional Chinese clothing. For instance, Die Xie belt (figure 2) is the one that combines two ways of carrying. Die Xie belt was originally an important accessory in the clothing of the Western Regions nomads with tools such as knives, syringes and whetstone. From the perspective of historical development, Die Xie belt removes the decoration and retains only the function, so its original leather belt and wrappage is an effective carrying tool, which should be the origins of clothing. It's in the course of human evolution that the core objects eventually become accessories for clothing.



Fig. 2. Golden Die Xie belt used for carrying tools

Finally, the emergence of the leather belt contributed to human evolution. The production of leather belt is the origin of human clothing; it is also a labour tool at the beginning. Ernst Grosse, a famous German art historian, pointed out that the original belt was usually not decorated, probably because the practical significance was large and the decorative purpose was small. The first function of the belt was to carry small weapons and tools, the second function being a waistband to alleviate hunger [14]. From this we can see that the prototype waistband of clothing is a form of people's own production of material life, being the creation of human intelligence in the motivation to improve the survival rate, a powerful means to get rid of the animal state, as well as a material confirmation of human freedom.

**Shaped clothing is a necessary means for humans to expand their living space**

Clothing is not only an important tool to improve the survival rate of human beings, but also a necessary means to expand the survival space of human

beings. The gradual degeneration of primitive men's hair fully demonstrates the importance of survival strategy change in the evolutionary process. However, the degradation of hair causes primitive humans to appear on the African savanna in a state of nature. With the growth of population and the shrinking of living space, some primitive humans left African continent in batches and spread to other continents in order to better survive. However, other continents are not as warm as the ancient African grasslands, and the degradation of hair requires human beings to improve their ability to withstand cold, especially the cold climate during the fourth ice age, which made primitive human beings face an unprecedented crisis. Humans can only solve this crisis effectively by developing a split clothing based on the belt, settling in caves, relying on fire to warm up, and covering the body with animal skins [15]. As a universal means of survival in other continents (Individual low-level primitive cultures may not have developed into this stage, but the degree of population and cultural development can be explained by the fact that there is no invention of clothing, and it is impossible to change from culture to civilization.). Without the invention of clothing, human beings would not be able to expand to all the continents of the world except Antarctica in a civilized manner. Therefore, the real formation of clothing is a necessary means for human beings to expand their living space. Therefore, the shape and structure of the original clothing is worth pondering. As an important tool of making clothing, in 1930, the discovery of bone needles was found in the ruins of the Upper Cave Man at Longgu Mountain in Zhoukoudian, Fangshan District, suburb of Beijing, fully indicating that animal skins and other materials from the late Palaeolithic age in China have been used to sew clothing, and the thread sewing the clothing may be a string split with animal ligaments [16]. According to the unearthed clothing tools such as bone needle and bone cone, Chinese scholars reconstructed primitive clothing (figure 3). It can be seen that this kind of clothing



Fig. 3. Recovery drawing of original shaped clothing



mainly covers the part of the body, and the rope belt made of leather is used to fix the clothes on the body, which should be the prototype of the original clothing. A large number of bone needles have also been found in the remains of the late Palaeolithic era worldwide. For example, there are bone needle fossils or bone needle discovery in the remains of Neanderthals, Kramaon people in Europe [17], or the Aboriginal in Australia and native Indian tribe in American. Therefore, in the late Palaeolithic period, the emergence of bone needles all over the world fully indicates that primitive people in this period were able to sew real clothes.

## CONCLUSION

For the study of the origin of clothing, there are some dilemmas in the research routes of philology, archaeology and anthropology. On the whole, the research route of philology is obviously the ancient people's research on primitive people's dressing motives, and there are some deficiencies in historical explanations of Whig. Due to the lack of cultural relics, the research route of archaeology cannot reasonably explain the time and material of clothing origin. The anthropological research route is also of a congenital defect that looks at the overall problem from a one

perspective. However, the combination of ancient Chinese character etymology and philosophy may be an effective way to solve the problem of clothing origin. From the perspective of ancient Chinese character etymology, the ancient Chinese characters related to clothing can fully prove that garments originated from carrying tools, and it is an effective means of primitive human survival. From a philosophical point of view, on the one hand, the emergence of clothing should be much earlier than the clothing consciousness, so the aesthetic consciousness can only be the motivation to promote the development of clothing rather than the root of the origin of clothing. On the other hand, clothing is a powerful tool, which greatly improves the survival rate of human beings. Based on the cross-analysis of ancient Chinese characters and philosophy, clothing originated from the need of carrying tools, whose initial form should be the leather belt. With the evolution and development of human beings, various shaped garments are finally produced in different regions.

## ACKNOWLEDGEMENTS

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# Deep insight on the behaviour of short fibres within a composite under uniaxial tensile

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## ABSTRACT – REZUMAT

### Deep insight on the behaviour of short fibres within a composite under uniaxial tensile

*This work presents an investigation of the mechanical properties of a composite structure manufactured from polypropylene matrix reinforced with jute waste fibres collected from textile industry with extrusion followed by injection techniques. Mechanical tests under uniaxial strain shows that this lightweight vegetal fibre significantly enhanced the mechanical performances of the whole composite with a very slight quantity of compatibilizer which positively influences the final price of the composite. The fracture surfaces showed highly tethered as well as weakly anchored fibres to the matrix. Moreover, in order to have a deep insight on that anchoring behaviour, uniaxial tensile deformation was applied under Scanning Electron Microscopy and evidenced how the fibre/matrix interface plays a high role to strengthen the whole structure. The fibre and matrix interface is not simply resumed to high or weak anchoring but there is a combination of sticking and slipping of reinforcement on the polymeric walls.*

**Keywords:** composites, natural fibre, mechanical performances, fibre/matrix interface

### Perspectivă aprofundată asupra comportamentului fibrelor scurte într-un compozit sub tracțiune uniaxială

*Această lucrare prezintă o analiză a proprietăților mecanice ale unei structuri compozite fabricate din matrice de polipropilenă armată cu fibre reziduale de iută colectate din industria textilă, realizată prin extrudare urmată de tehnici de injecție. Testele mecanice sub tracțiune uniaxială arată că această fibră vegetală ușoară îmbunătățește semnificativ performanțele mecanice ale întregului compozit, cu o cantitate foarte mică de compatibilizator care influențează pozitiv prețul final al compozitului. Suprafețele de fractură au prezentat fibre foarte legate, precum și slab ancorate în matrice. Mai mult, pentru a avea o perspectivă detaliată asupra acestui comportament de ancorare, deformarea la tracțiune uniaxială a fost aplicată la microscopia electronică cu scanare și a evidențiat modul în care interfața fibră/matrice joacă un rol important în consolidarea întregii structuri. Interfața fibră și matrice nu este pur și simplu reluată la o ancorare ridicată sau slabă, ci există o combinație de lipire și alunecare a armăturii pe pereții polimerici.*

**Cuvinte-cheie:** compozite, fibră naturală, performanțe mecanice, interfață fibră/matrice

## INTRODUCTION

In recent years, regarding some ecological, technical as well as economic reasons, the integration of natural cellulosic fibres within thermoplastic matrix as reinforcements of composite structures has drastically increased [1, 2]. Compared to high performance fibrous structures like carbon and glass fibres, natural cellulosic ones present no health risks for manufacture employees or end users. Markets associated to these composites are touching a wide range of applications in many industrial fields like transport and buildings. Automotive application is a field that uses many technical textile fibres as reinforcement for polymer composite, in particular, composite based on nonwoven materials made with short fibres. Recently, extensive research has been carried out on the application of natural fibres as reinforcement in a polymer composite [3], thanks to their availability, renewability, low density and low cost. Composites with thermoplastic resins are industrially preferred to thermosets as they enable lower processing costs due to low production cycle. Several natural fibres have been used as reinforcement of composites with

thermoplastic polymer matrix [4], and those studies investigated the mechanical and thermal performances such impact strength, elastic modulus, thermal resistance... It has been shown that the key factor to reach high performances composites is the compatibility between matrix and fillers. The natural affinity between these components avoids chemical compatibilization and leads to low-cost materials. In this paper, we use raw and chemically treated jute fibres as reinforcement. The valorisation by recycling of this industrial waste issued from spinning and weaving local industries to produce eco-friendly industrial products is an important economic and ecological challenge [5]. Many works have been conducted to explore the benefits of natural cellulosic fibres in a variety of applications like renewable dyes filters [6], production of cellulosic derivatives [7] or as matrix reinforcement [8]. This latter application is the object of this work, where the main focus is not only the mechanical performances of the composite, but we will mainly focus on the behaviour of the fibre/matrix interface under uniaxial tensile. For that reason, apart from the mechanical performances of

the samples tested by classic dynamometry, a tensile device has been integrated within the Scanning Electron Microscope to pursue how fibres behave when a breaking tensile deformation is applied to the composite structure.

## MATERIALS AND METHODS

### Fibres' extraction and composites preparation

Fibres have been collected from wastes issued from spinning and weaving industries of jute fibres. They were placed on a horizontal opener. They are driven by a rolling lurking and then they are engaged in a threshing cylinder. Subsequently, they are driven by means of a toothed roller in order to separate fibres. By centrifugal force and aspiration, fibres are driven upwardly and the waste falls down. The fibre obtained after this mechanical treatment will be considered as raw fibres. The treated fibres were submitted to alkaline treatment involving the use of 20 g/l of sodium hydroxide and 10 g/l of sodium hypochlorite in mixture with a 1/100 fibre/bath ratio. This system is maintained at 100°C for 60 min. The treated fibres are then rinsed with hot water and dried in an oven at 105°C for 20 min. This chemical treatment strengthens the fibres by eliminating some non-cellulosic components and removes impurities from fibre surface which improves the fibre/matrix interface [9, 10]. The composite material was prepared using an internal mixer (Haake Rheomix 600), coupled to a Polylab Rheocord 300p data acquisition system. This device allows mixing of rather small volumes of materials of 69 cm<sup>3</sup> but it was filled to 70% of its capacity to ensure high compounding. The preparation follows three steps: at first, the polymer pellets are introduced in the mixer chamber heated to 180°C with contra rotative rollers turning at 100 rpm. This step remains 2 min to ensure the matrix melting. Then, in the second step which lasts 6 min, equal bursts of fibre are progressively introduced to the chamber every 2 min and that was found to allow an optimized compounding of fibres and matrix. When all the quantity of fibres is introduced into the chamber, the mixing lasts 2 minutes before stopping the rollers and extracting the composite. This latter will then be transformed into pellets using Reitsh grinding device equipped with a grid of 5 mm in diameter. Finally, pellets are injected at 180°C a Haake Mini Jet II press to obtain dog bone samples according to ISO 527-2 standard. The matrices of our study were polypropylene (PP) and polypropylene mixed (PPm) with anhydride maleic grafted polypropylene (AMgPP). PP and AMgPP were, respectively, supplied by Total Petrochemicals and Arkema and commercialized under the nominations PPH 5060 and Orevac CA-100. The densities of fibres and polymers were measured using a pycnometer AccuPyc II furnished by Micromeritics. Measured densities are 1.5369 g/cm<sup>3</sup> for raw jute fibres, 1.4666 g/cm<sup>3</sup> for treated fibres, and 0.8845 g/cm<sup>3</sup> for the matrix.

### Mechanical analysis of composites

The tensile test of the specimen were determined using universal testing machine (Instron), according to ISO 527, with a traveling speed of 0,8 mm/min and a cell of 30 kN. The distance between clamps for traction is fixed to 60 mm.

### Scanning Electron Microscopy (SEM)

Surface topography of raw and treated fibres as well as fracture surfaces of the composite structures were observed with a Quanta 200 FEG (FEI Company) in environmental mode at an acceleration voltage of 3 keV and a pressure of around 0.7 Torr. The fibre and fracture surfaces were coated with carbon to avoid any degradation during observation. The SEM was equipped with an in situ tensile apparatus (DEBEN micro test, maximum load 5 kN) and direct observations of the crack propagation were done at a displacement speed of 0.1 mm/min on notched specimens. Experiments were conducted on three samples per blend.

## RESULTS AND DISCUSSIONS

### Morphological properties of the jute fibres

Raw and treated jute fibres are presented in figure 1. The morphology of that fibre is presented as a beam of continuous elementary fibres joined together with lignin and pectin. When fibres are chemically treated, the fibres surface seems to be cleaner, and the stripes between the elementary fibres become more distinguishable. This cleaning contributes to a better affinity between the matrix and the reinforcement.

### Effect of fibre ratio and fibre/matrix compatibilization on the mechanical performances of composites

The experiments associated to the effect of both fibre ratio and fibre treatment on the mechanical properties are summarized on the table below. We did not split the results as usually done because these effects are generally well known and extensively treated in the literature, whereas the main purpose of our work is to show the internal morphology of the composite structure when submitted to tensile strength.

First of all, the incorporation of fibres into the matrix increases the elastic modulus of about 49% for the less rigid combination associated to 10% of raw fibres fraction. It could reach 140% for 20% of chemically treated short jute fibres. The increase of fibres ratio increases the mechanical performances of the composite structure. This is essentially due to the increase of the contact area between matrix and reinforcement that help to transfer the stress from one component to the other toward their interface. This result evidenced the importance of the compatibilization between the fibres and the matrix leading to stronger adhesion and better stress transfer leading to better resistance to uniaxial tensile stress in the elastic region and also before total break [12–15]. This deduction is confirmed as we apply a chemical

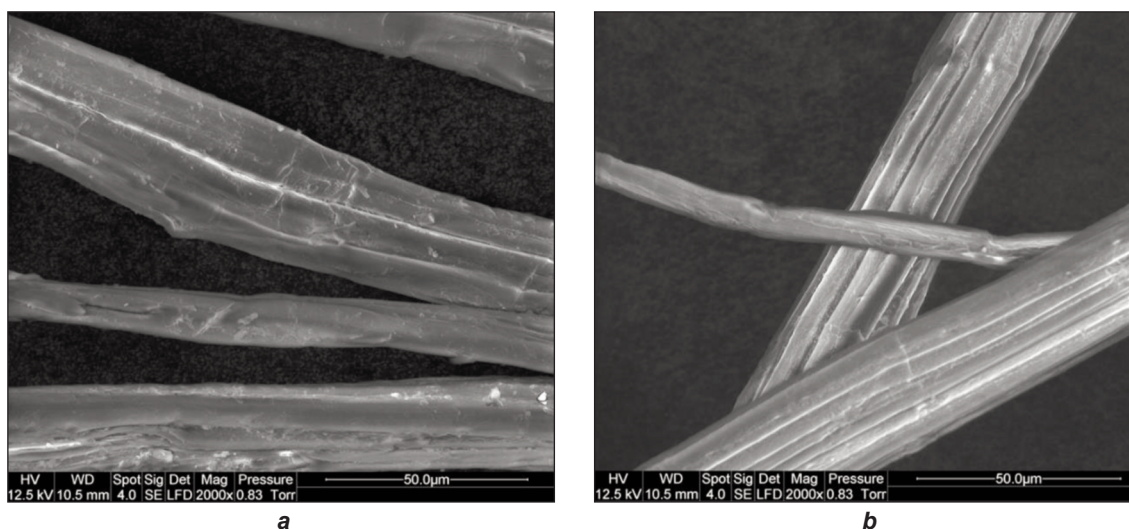


Fig. 1. SEM micrographs of jute fibres: *a* – in raw state; *b* – treated chemically

treatment to the reinforcement. In fact, the alkali treatment applied to the fibres increases the elastic modulus by around 17% for both fibres ratios. The break resistance is improved as well. The compatibilization is responsible of the fibre/matrix adhesion improvement which also leads to a better dispersion of the fibres within the matrix [5, 11]. The failure surfaces associated to the raw fibres have been focused on with SEM presented on figure 2 and show the existence of voids or protruding fibres for raw reinforcement. We could also notice some fibres footprint on the matrix. These phenomena are explained by the fact that fibres have been exfoliated from the matrix without breakage. So, the interface did not play a strong role to maintain the compactness of the whole structure. In the other side, better adhesion between the fibres and the matrix could be seen when fibres are chemically treated. It generates a better coating of the fibres with the matrix presented on figure 3. This high bonding energy leads to a breakage of the fibres and we morphologically observe broken fibres and not highly protruding from the matrix.

Table 1

MECHANICAL PERFORMANCES OF COMPOSITE MATERIALS FOR VARIOUS TREATMENTS AND FIBRE RATIOS			
Specimen	Fibre weight ratio (%)	Young Modulus E (MPa)	Stress $\sigma$ (MPa)
Matrix PP/PPgMA	0	1230 ± 75	19 ± 1.2
Matrix/raw jute	10	1837 ± 90	26 ± 1.5
Matrix/raw jute	20	2714 ± 166	29.1 ± 1.75
Matrix/treated jute	10	2150 ± 154	28.2 ± 0.75
Matrix/treated jute	20	3159 ± 211	34.5 ± 2.5

Nevertheless, these conclusions are based only on the final state of the broken samples. They are most likely deductions from final states observed on SEM. In fact, the breakage of fibres could succeed a slight slippage inside the structure and a protruding fibre could occur after breakage of this reinforcement in

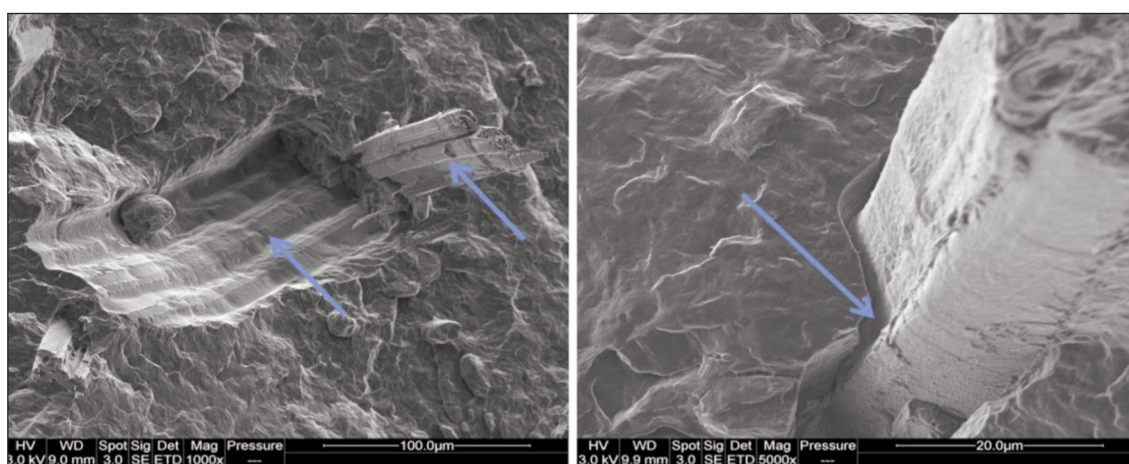


Fig. 2. Fracture surface of composite reinforced with raw fibres, effects of weak tethering of the fibre to the matrix indicated with arrows

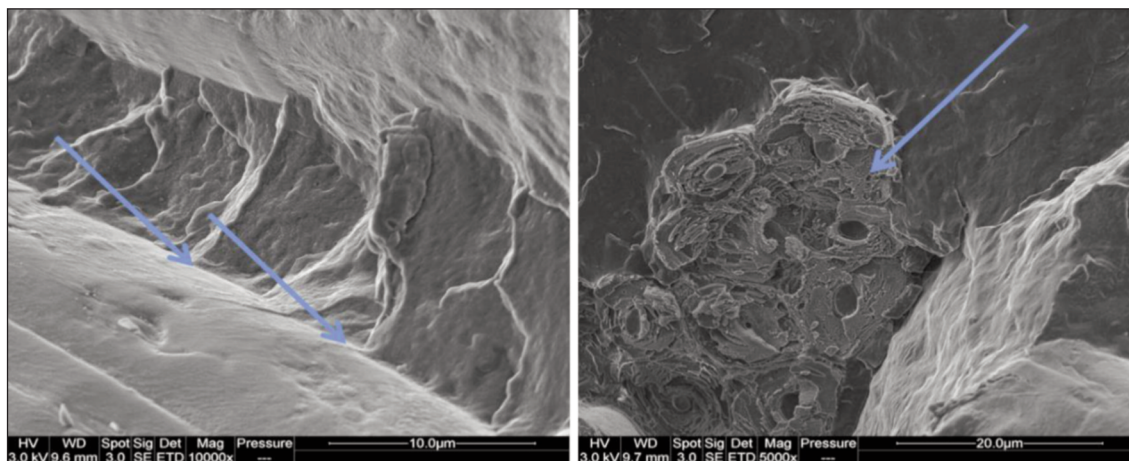


Fig. 3. Fracture surface of composite reinforced with treated fibres, effects of improvement tethering of the fibre to the matrix indicated with arrows

the internal part of the matrix. In that case, we are facing a problem of a partial efficient adhesion which may be associated to non-homogeneous chemical treatment of the fibres. To have a deeper insight on what happens within the structure; it becomes necessary to have highly amplified SEM micrographs in situ to pursue the fibres behaviour during uniaxial deformation until breakage.

#### Fibre behaviour under tensile strain inside the composite structure

This study is based on morphological observations under SEM. The composite surface has been finely eroded mechanically until fibres become clearly apparent. That action does not affect the fibre matrix contact. This operation helps to detect the movement of the fibre clearly by the microscope. A slight notch was applied on one lateral side of the material to ensure that failure will take place around the notched region and focus the microscope there. The samples have been submitted to uniaxial strain at a velocity of 0.1 mm/min until failure. Elongation and force associ-

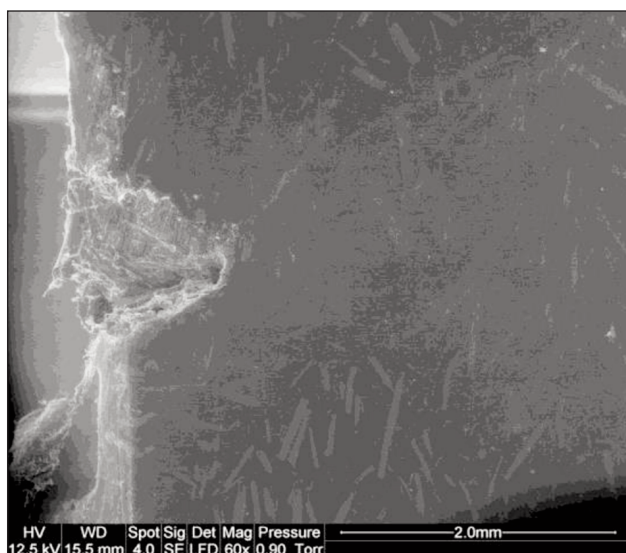


Fig. 4. SEM micrographs associated to eroded composite surface showing raw fibres distributions and notched region

ated to each specific micrographs are indicated on high corner in millimetre and in Newton, respectively. Figure 4 shows the notch and the distribution of fibres on eroded surface eroded composite. It evidenced an isotropic distribution of fibres within the resin. When submitted to uniaxial strain, fibres could be split into three main groups, those oriented in the direction of the strain, those perpendiculars and those with oblique orientation.

We focus on the fibres around the notch to detect their behaviour under uniaxial mechanical traction as the notch is considered as the weakness zone where fracture must occur. Figures 5 and 6 present the behaviour of raw fibres inside the composite submitted to uniaxial strain, these fibres have orientations belonging to the three groups cited above. Applied strain is indicated on each microscopic shot. Wide images present the localization of the pursued fibres within the structure, and then we focus on the behaviour of this zone by enlarging it to detect details.

For fibres almost oriented in the direction of strain, we observe on figure 5 two phenomena; the first one is indicated with circles and consists on a detachment of the fibre from the matrix then slippage, inducing a void on the fracture surface or a protruding fibre in the second fracture surface. The second phenomenon is the breakage of the fibre then its detachment as indicated with rectangle. That fact means that tethering between fibres and matrix exists but presents some weakness points.

When fibres are lying toward the structure, the interface is much more solicited and it brakes rapidly as shown by different arrows types on figure 6. At that stage, physical affinity does not have any efficiency to transfer the stress and a strong chemical tethering is needed to reinforce the whole material.

When chemical treatment is applied to the fibre, chemical bonds take place leading to more compaction of the whole structure. This affects the mechanical performances of the composite (elasticity and/or fracture stress) and is generally attributed to better stress transfer between fibres and matrix.

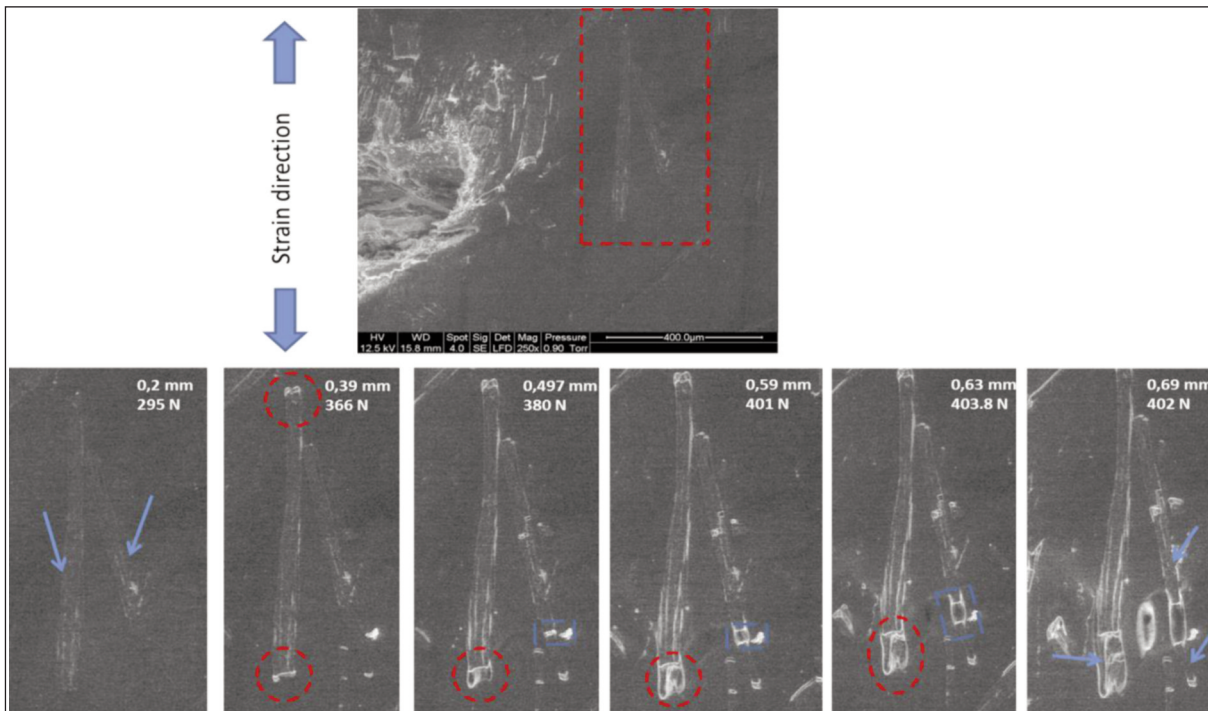


Fig. 5. SEM micrographs associated to raw fibres and matrix interfaces when submitted to uniaxial strain, fibres are mostly oriented in the direction of strain

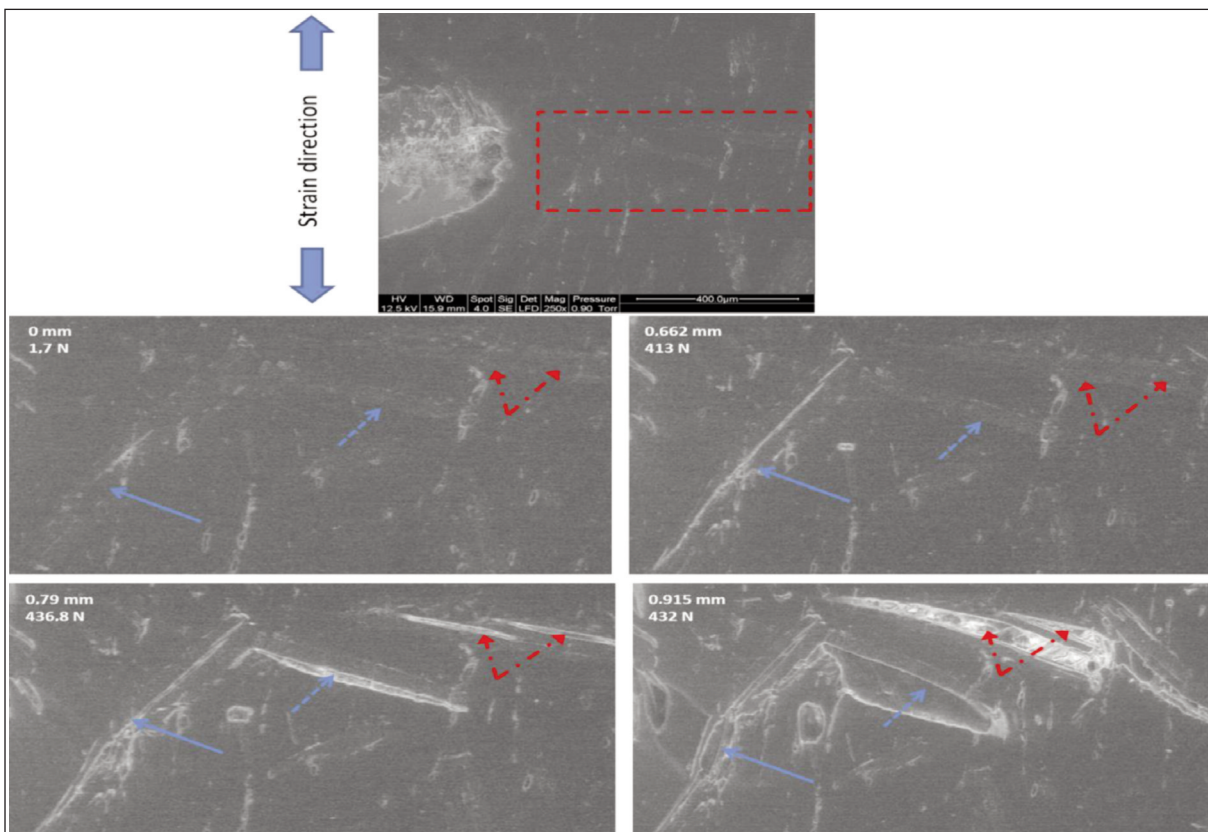


Fig. 6. SEM micrographs associated to fibres and matrix interfaces when submitted to uniaxial strain, arrows indicate interface detachment

Figure 7 confirms these hypotheses. It shows the behaviour of the fibres treated chemically inside the matrix submitted to strain. It evidences fibres failures more than detachment and slippage outside the structure.

That will be depicted on fracture surfaces by much more broken reinforcements than voids. Of course, voids will always exist but less in number as far as the chemical bonds between fibres and matrix are strong.

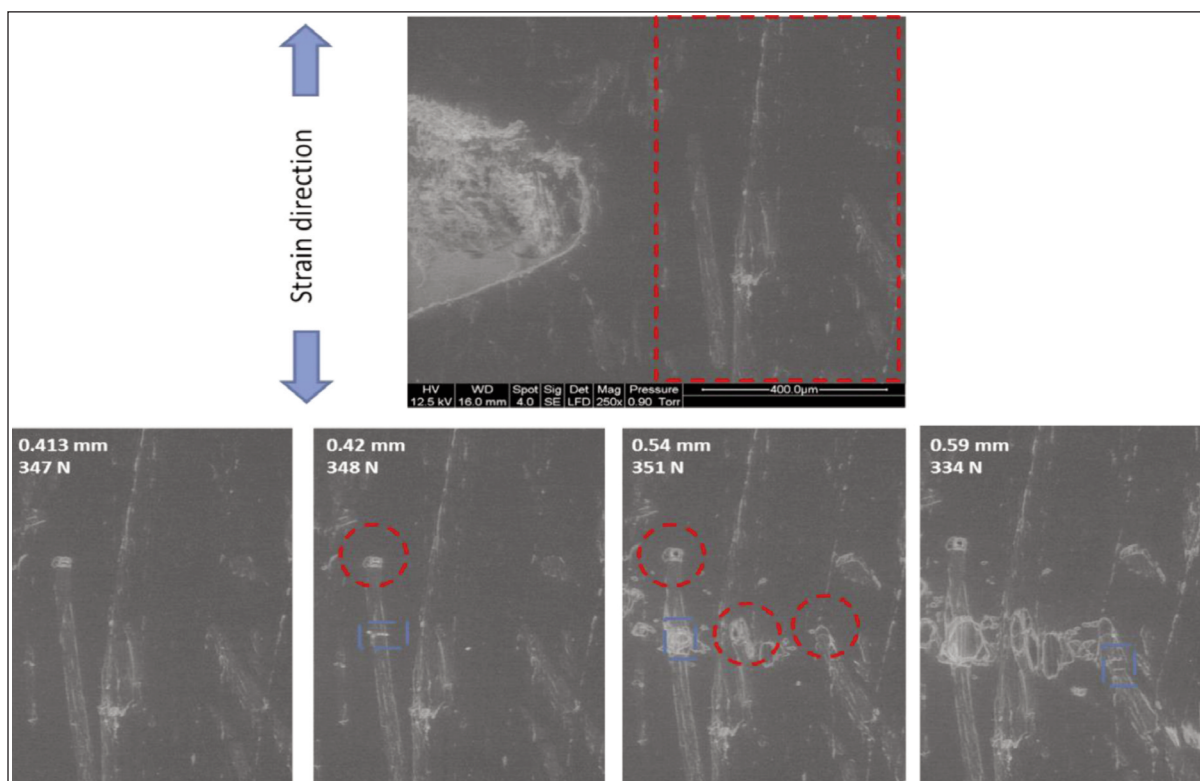


Fig. 7. SEM micrographs associated to treated fibres and matrix interfaces when submitted to uniaxial strain, detachment is indicated with red circles and fibre break with blue rectangle

## CONCLUSIONS

This paper investigated the mechanical properties of composite material reinforced with raw and chemically treated jute fibres. Composites showed usual encountered tendencies for mechanical performances which are enhanced with fibre ratio increase and the addition of compatibilization treatments. We focused on the fibre/matrix interface when the composites are submitted to uniaxial strain by pursuing the fractured region under SEM. It has been shown that fibres have isotropic orientation inside the matrix. For low bonding strength, vertical and oblique oriented fibres are detached from the matrix but could be also fractured than untethered from the resin by slippage. That observation evidenced a non-homoge-

neous contact between fibres and matrix. Fibres which are mostly oriented perpendicularly to the strain direction are detached from one side of the fractured sample leading to fibre footprint on the fracture surface. When the fibre/matrix interface is improved with chemical treatment, fibres stick stronger to matrix leading to their fracture. Some fibres break inside the matrix then are detached and some voids are observed on fracture surface. The interpretations associated to such voids could not be confirmed using common deductions which stipulate the detachment of the whole fibre, but we must have deep insight on that behaviour, for example by using the method proposed in this research work.

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# Consumers' assessment of the brand equity of garment brands

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## ABSTRACT – REZUMAT

### Consumers' assessment of the brand equity of garment brands

*The assessment of brand equity and its sources is a trend among researchers and garment brand companies nowadays. The purpose of the current study is to explore the impact of two independent variables, including “words of mouth” (WOM) and “brand personality”, on the dependent variable “brand equity”, along with the assessment of mediating effects of “relationship quality”. Previous literature on the subject suggests that multiple sources including “words of mouth” and “brand personality” influence “brand equity”, but no attempts have been made for the assessment of “relationship quality” as a mediator among sources of brand equity in the context of garment brands. The present study aims at filling that gap through the presentation of a statistical model. Respondents in the sample included the regular customers of the garment brands. Partial least squares structural equation modelling (PLS-SEM) was used to process the collected data. The results indicated that the “WOM” and “brand personality” had a significantly positive influence on “brand equity”. “Relationship quality” was found to have a strong mediating effect. The theory of brand equity and the social exchange theory was used to develop a representative model. Results of the study strengthen the premises of the theory of brand equity and the social exchange theory. The researchers recommended the exploration of the influence of other possible mediating variables in future researches. Recommendations were also made for the administrators of the garment brand companies for the consideration of “relationship quality” along with the sources of “brand equity”, including “words of mouth” and “brand personality” for improved decision making and competitive advantage.*

**Keywords:** brand equity, word of mouth, brand personality, brand relationship quality, garment brand companies, social exchange theory

### Evaluarea de către consumatori a valorii brandului pentru mărcile de îmbrăcăminte

*Evaluarea valorii brandului și a surselor sale este o tendință în rândul cercetătorilor și al companiilor de branduri de îmbrăcăminte din zilele noastre. Scopul studiului actual este de a explora impactul a două variabile independente, inclusiv „publicitatea din gură în gură” (WOM) și „personalitatea brandului”, asupra variabilei dependente „valoarea brandului”, împreună cu evaluarea efectelor mediatore ale „calității relației”. Literatura anterioară pe acest subiect sugerează că surse multiple, inclusiv „publicitatea din gură în gură” și „personalitatea brandului” influențează „valoarea brandului”, dar nu s-au făcut încercări de evaluare a „calității relației” ca mediator între sursele de valoare a brandului în contextul brandurilor de îmbrăcăminte. Prezentul studiu își propune să umple acest gol prin prezentarea unui model statistic. Respondenții din eșantion au inclus clienții obișnuiți ai brandurilor de îmbrăcăminte. Modelarea ecuațiilor structurale cu cele mai mici pătrate parțiale (PLS-SEM) a fost utilizată pentru a analiza datele colectate. Rezultatele au indicat că „WOM” și „personalitatea brandului” au avut o influență semnificativ pozitivă asupra „valorii brandului”. S-a constatat că „calitatea relației” are un puternic efect de mediere. Teoria valorii brandului și teoria schimbului social au fost utilizate pentru a dezvolta un model reprezentativ. Rezultatele studiului întăresc premisele teoriei valorii brandului și ale teoriei schimbului social. Cercetătorii au recomandat explorarea influenței altor posibile variabile mediatore în cercetările viitoare. De asemenea, au fost făcute recomandări pentru administratorii companiilor de branduri de îmbrăcăminte pentru luarea în considerare a „calității relației” împreună cu sursele de „valoare a brandului”, inclusiv „publicitatea din gură în gură” și „personalitatea brandului” pentru îmbunătățirea luării deciziilor și a avantajului competitiv.*

**Cuvinte-cheie:** valoarea brandului, publicitatea din gură în gură, personalitatea brandului, calitatea relațiilor de brand, companiile de branduri de îmbrăcăminte, teoria schimbului social

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## INTRODUCTION

In this competitive business age, every business organization and firm, including well-known ones, depends on branding for their survival as having a good reputation and a brand name enhances a firm's profit [1]. A “brand” can be explained as a unique name or a symbol (such as trademark, logo) to identify the

customer's goods or services or a group of sellers from others who are providing similar goods and services [2]. A brand is highly successful when it distinguishes itself from its competitors through better customer service. In addition, a brand with a good reputation makes it easier for consumers to choose a reliable product or service due to a high level of trust

and good quality. For companies, a brand with high brand strength will ensure consumer preference, purchase intention, excessive customer loyalty, more considerable margin gains, market share, less vulnerability to competitive attacks, consumer price insensitivity, additional brand lengthening opportunities, more cooperation from trade, resilience to product-harm crisis and other intermediaries [3]. These factors add value to a brand, and that added value ensures “brand equity”.

Brand equity refers to a brand’s value determined by consumers’ experience with and perception of the brand [4]. The achievements and performances of brands in the market are evaluated through brand performance and brand equity. Brand equity strongly affects business operations and development and, therefore, is classified by researchers as a nucleus concept in branding [5]. The brand with high brand equity enjoys better consumer association and well-established acquaintance in the market [4]. Marketing researchers have attempted to conceptualize measures of brand equity that drive a brand’s market performance. Some scholars [6, 7] concluded that companies are moved toward scrutinising brand equity for two purposes. The first purpose is the estimation of a more defined value of the brand for financial reporting. The second purpose is the formulation of a strategy to upgrade marketing efforts for increased profits.

Furthermore, Jamil et al. [8] claimed that assessing the brand from the customer’s point of view is necessary for market performance nowadays. These findings demonstrate that brand equity is based on consumers’ perceptions. Therefore, according to Jamil et al. [8], the source of brand equity rolls up from customers’ perception, which is why considered critical to review brand equity at the customer’s level.

Products achieve high brand equity when consumers positively respond to any marketing efforts by the brands. The marketing effort refers to any marketing activity that has a potential effect in establishing and crafting substantial brand equity in consumer’s minds [9]. The branding literature states that the marketing efforts are predictors or sources of brand equity, and they are considered crucial as they may increase or decrease brand equity. Davcik [3] noticed that business drivers also serve as essential sources of brand equity. In short, both marketing efforts and business drivers play significant roles in influencing the formation of brand equity.

Garments brands are considered to be active business entities all around the globe. Investigators [10, 11] recommend garment companies to focus on brand management practices as a strategy because they can ensure benefits in the highly competitive market. Moreover, the examiners have stated that the branding takes part in small and medium business development, particularly making an allowance for SME market activity [5]. It is well-known that firms have restricted resources and budgets whereas, brand management is expensive. However, Jamil et al. [13] acknowledged that these constraints could be

overcome if a firm understands the importance of branding.

Literature on brand equity suggests that multiple sources of brand equity, including words of mouth and brand personality, influence brand equity, but no attempts have been made to assess mediating properties of relationship quality in the context of garment brands in Pakistan. Therefore, this study will investigate the effects of “words of mouth” and “brand personality” on “brand equity” along with the assessment of “relationship quality” as a mediator.

## LITERATURE REVIEW

### The brand equity

The accomplishment of brands in the market can be evaluated through brands’ performance in branding their products and services as branding is a good predictor of business performance [14]. Therefore, brand equity is among the numerous indicators for the assessment of brand performance. Since this concept came into being, many researchers have been defined brand equity in different ways. It started to gain the attention of researchers in the late 1980s [15].

To understand brand equity, one should use consumer-based brand equity (CBBE) for better understanding. For the success of brand management, consumers should deeply understand the concept of brand equity. CBBE is used to gain an insight into consumers’ knowledge, familiarity, experience and associations with the brand [16]. The CBBE model is the most appropriate model that can be implemented to understand multiple factors, including the inability of several brands to perform well and troubles faced by stronger brands. When its assessment is used in strategy management, it is found to impact a company’s financial performance strongly. Resultantly, brand equity has become the subject of many studies in the literature. Brand equity from consumers’ perception is also known as customer-based brand equity, which can be calculated through a direct or indirect approach [16].

Researchers have used different approaches to develop brand equity sources or constructs, making this field somewhat ambiguous. Previous studies on the constructs or predictors of brand equity have been mainly observant on tangible factors of the marketing mix, which includes advertising efforts, price, store image, distribution intensity, advertising expenditure and price promotions, marketing communication, marketing mix, brand personality and sales promotion power, celebrity endorsement and event sponsorship [16].

### Word of mouth and brand equity

A literature review suggests that the functions of WOM, either the traditional WOM or e-WOM, have been investigated plenty of times, focusing on the marketing field. The literature demonstrates that WOM impacts purchase intention, brand equity, brand equity dilution and membership growth [17, 18]. A WOM has a considerable effect in influencing consumers’

perceptions. It also plays its role in the formation of an approving consumer's attitude and behavioural intention. It was narrated by Sekaran and Bougie [16], where they declared that the influence of WOM on brand equity has not yet been widely studied. Researchers noted that brand personality is a central promotional tool in differentiating a brand from its competitors [19, 20]. It was illustrated in an empirical study by Muhammad et al. [21] that brand personality has a principal relationship with an element of brand communication which is positive WOM. That explanation led the researchers to assume that brand personality and WOM are correlated and have to be investigated more to have a comprehensive understanding of its strength. But despite a lot of investigations on the subject, literature regarding the role of WOM in the formation of brand equity still lacks generalizable evidence.

### **Brand personality and brand equity**

There has been frequent production of literature about brand personality and brand equity. Dunnan et al. [22] stated that brand personality is the mainstay dimension of brand image that needs to be considered an essential factor during efforts to build a strong market presence in the market. Numerous researchers consider brand personality one among the leading sources of brand equity. Brand personality inspires brand loyalty, brand preferences and brand attachment. Brand attachments and brand preferences make their ways to brand equity. Meanwhile, brand trust and brand loyalty are the sections of brand equity [1].

Brand personality has been proven to join in a meaningful role in ensuring brand loyalty, forming a positive attitude towards the brand, and boosting brand equity [15]. Earlier findings revealed that brand personality enables consumers to different product types into product categories, enhancing customer needs and loyalty to brands and managing similarities. Accordingly, brand personality and equity are two interlinked branding constructs that must be comprehended when designing a brand management plan. On the other hand, only a few researchers appeared to have inspected the effect of brand personality on brand equity [23].

The studies on brand personality in Asia, especially in Pakistan, are limited [24]. Moreover, the literature indicates that it is only to conduct empirical studies to examine the impact of quality on brand management in garment brands. This is why Valette-Florence et al. [24] proposed that further investigation is required to re-confirm the influence of ethics on brand management. In addition, the investigators Seimienea and Kamarauskaiteb [25] urged the need for other studies to look into the impact of personality traits on racial equality.

### **Relationship quality as mediator**

A mediating variable serves as a bridge to the relationship between independent and outcome variables. It is a matter of skill when it comes to defining

the relationship between variables and the mediator [26]. The use of the mediating variable in any study enriches its research design and findings [27]. To enhance the current research findings, relationship quality would be analyzed as a mediator among dependent and independent variables. Relationship quality is an important concept that was introduced by Gammoh et al. [7] and consolidated by Dwyer and Oh [28] and noted further by numerous investigators over 29 years [29, 30]. The idea of relationship quality came to light from an extended issue of relationship marketing. Mohsin et al. [31] asserted that relationship quality is the term used to measure customer perception of how well the relationship meets the terms of consumer's hope, predictions, goals, and requirements. In Pakistan, random research has looked into the effects of relationship quality as a mediating variable [32]. Safeer et al. [6] conducted their studies in Pakistan and described that relationship quality intervenes among product innovation, service quality and brand equity.

Moreover, Seimienea and Kamarauskaiteb [25] has also discussed the intervening role of relationship quality among innovativeness, market orientation, learning orientation, and firm performance.

## **MATERIAL AND METHODS**

### **Data collection and sampling technique**

The investigation examined consumers' perception of brand strength. Self-administered questionnaires were administered among customers of garment brand companies in the shopping malls and famous markets of Islamabad, Pakistan. Researchers received formal approval from the administration of shopping malls. Before distributing the questionnaires, the purpose of the research was conveyed to the respondents. Informed consent was obtained from all the respondents. The researchers followed all the research ethics during the data collection phase. The data collection phase continued for over five weeks (25 April 2019 to 29 May 2019). One hundred thirty-eight questionnaires were distributed among the respondents. One hundred seventeen were given back. Fifteen of the remaining questionnaires were left out as they were not fully answered. After the conduction of outliers' assessment, only 101 questionnaires were selected for final analysis. Two software were used for data analysis. Statistical Package for Social Science (SPSS) version 22 was used for the analysis of descriptive statistics. Secondly, Partial Least Square Path Modeling (PLS), a component-based Structural Equation Modeling (SEM) system, was drawn.

### **Research measures**

Brand equity was adopted from a previous study [15, 33] and calculated with six items. WOM was adopted from Bambauer-Sachse and Mangold [17] and was computed with six items. Additionally, brand personality was adopted from Hanaysha [34], which also

comprised of six items. Finally, the relationship quality was adopted from Safer et al. [6] with five things.

## RESULTS

### Measurement model assessment

Reliability and validity have been used to calculate the measurement model [34]. The combination of factor loading and composite reliability are the main elements to determine the model's reliability under discussion [35]. Figure 1 clearly explains that all the factor loadings and composite reliability are above the thrash hold value, which is 0.70, and it proves that all the model items are reliable. The average variance extracted (AVE) and composite reliability assesses the measurement model [23]. Figure 1 shows that AVE and CR for all the items are above the thrash hold value as 0.5 and 0.7, respectively, proving the convergent validity (table 1).

### Structural model assessment

After assessing the measurement model, the structural model valuation was obtained with the assis-

Table 1

DISCRIMINATE VALIDITY OF THE VARIABLES				
Variables	BE	BP	RQ	WOM
BE	<b>0.787</b>			
BP	0.714	<b>0.767</b>		
RQ	0.824	0.744	<b>0.760</b>	
WOM	0.548	0.613	0.608	<b>0.816</b>

tance of Smart PLS 3.0. Finally, though, consequent tests in the structural model assessment were carried out.

### Hypothesis testing

Referring to Hair et al. [36] recommendation, if the value of VAF is less than 20%, it can be concluded as the absence of mediation. In contrast, the higher outcome of VAF value of over 80% indicates complete mediation. Therefore, the value of VAF between 20% and 80% can be characterized as partial mediation. For this study, the value of VAF is indicated in table 2 and table 3.

In conclusion, the findings confirmed that relationship quality plays a fully mediating role between WOM and brand equity. Besides, relationship quality partially mediates the relationship between brand personality and brand equity.

## DISCUSSION AND CONCLUSION

In this study, mouth's word was measured through Bambauer-Sachse and Mangold [17] scale. As mouth's word effects more at the information-gathering stage, the questions in this investigation are more on information search. The evaluation shows that positive words of mouth have a considerable and positive effect on brand equity. The results of this study supported the theory of brand equity, whereas [2, 5] declared that WOM included in the components of brand communication could enhance brand equity and power.

The researchers concluded that the brand personality affects brand equity positively and considerably ( $\beta = 0.211$ ,  $t\text{-value} = 9.061$ ,  $p = 0.000$ ). The outcomes are coherent with early studies that inspected how brand personality affects brand equity's creation [25, 15].

In this research, brand personality defines human characteristics that are appropriate for brands [34]. This research used [34] brand personality

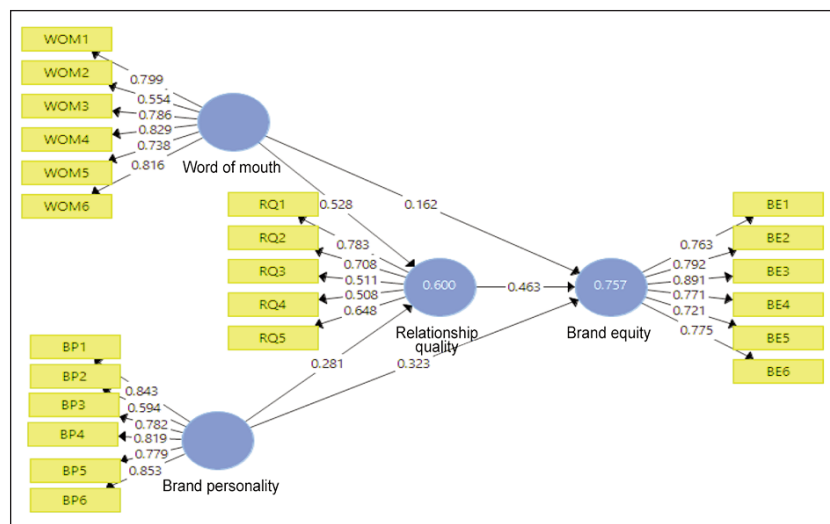


Fig. 1. Measurement assessment model

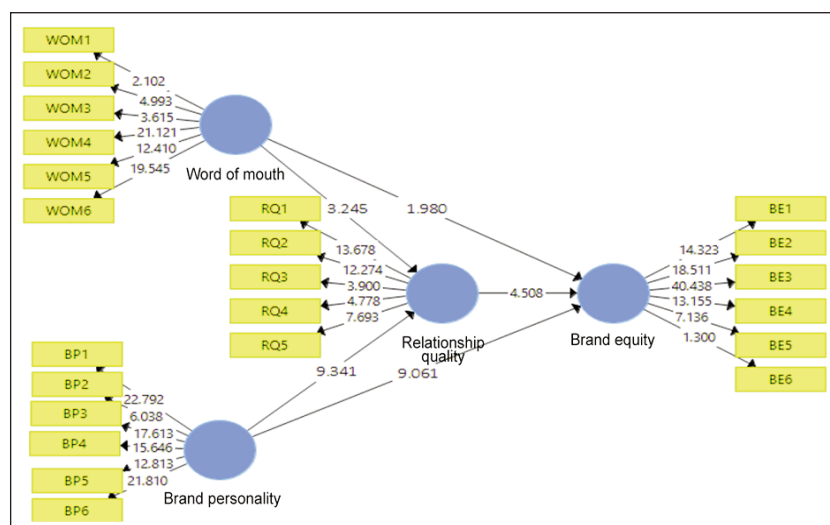


Fig. 2. Results of the structural model

Table 2

HYPOTHESIS SUMMARY						
No.	Hypotheses	Path coefficient	S.D.	T-value	P-Value	Decision
H1	WOM → BE	0.010	0.052	1.980	0.024	Accepted
H2	BP → BE	0.211	0.055	9.061	0.000	Accepted
H3	WOM → RQ → BE	0.148	0.046	3.245	0.001	Accepted
H4	BP → RQ quality → BE	0.451	0.048	9.341	0.000	Accepted

Table 3

MEDIATING VALUE				
Relationship	Indirect effect	Total effect	VAF (%)	Effect of mediation
WOM → BE	0.093	0.103	90.29	Full mediation
BP → BE	0.283	0.494	57.29	Partial mediation

measurement to consider consumers' brand personality. Evaluations have shown that consumers' brand personality positively affects brand equity. Therefore, the results of this study supported the theory of brand equity, whereas Aaker [2] declared characteristics are an essential part capable of enhancing brand equity and power. Furthermore, this research also highlighted that brand equity and brand personality have a positive relationship in garment companies. Earlier studies supported the positive association of brand equity and brand personality regarding Global brands only (e.g., Nike, Sony, Pepsi, and Coca-Cola). Based on this outcome, Firms are recommended to develop a personality appropriate to encourage people to use their product. In other contexts, owners of garment brands can set the brand's personality to accommodate the self-expressions of clients by using the brand equity's sources such as advertisement as it is supposed to develop a brand personality.

For WOM, this research revealed the quality of relationship arbitrates the relationship between brand equity and a mouth's word. Furthermore, this research concluded that terms of mouth and relationship quality have a positive relationship. Early studies supported these findings [18] in which a positive relationship was found between the mouth's word and relationship quality. Therefore, WOM has been proved as a significant construct ( $R^2 = 0.647$ ).

## IMPLICATIONS

This research is meant to be beneficial in several ways. Firstly, this contributes to the marketing knowledge, predominantly to the theory of brand equity building. The findings presented empirical evidence of the multidimensionality of valid code from the customer's template. The research context came from developing [2] model through the incorporation of Hair et al. [36] point of view. This research also supported Aaker [2] and File and Prince [30] conceptualization of brand equity. In Aaker's model [2], brand equity includes four brand equity assets (which were

referred to as brand awareness, brand association, perceived quality and brand loyalty). Many previous studies, including [7, 22], reported the multidimensionality of brand equity consumers based on the work of Aaker [2].

However, preceding studies that purposely focused on sources of brand equity on the creation of brand equity in garment brands may still be limited. Hence, the research adds up the views on the impact of predictors of brand equity on the creation of brand equity in garment companies by using data

from actual consumers to explore the dimensionality of brand equity consumer-based construct empirically. Moreover, the research also helps the body of knowledge by strengthening the Brand Equity Process Model (BEPM) and the fundamental theory of Brand Equity.

Another contribution of this study is identifying relationship quality as an effective marketing strategy in brand-building efforts. The positioning of relationship quality as a mediator in the relationship between WOM and brand personality and brand equity also contributes to the theory of brand equity and social exchange theory. However, the mediator effect was neither presented previous work [2, 30, 34, 38].

Additionally, trust, commitment, and other variables such as satisfaction were applied in Pakistan's garment brand sector.

## LIMITATION AND FUTURE RECOMMENDATIONS

The paper adopts a cross-sectional design that does not permit causal inferences to be generated from the population. Hence, a longitudinal design is recommended in the following research to measure the theoretical constructs at several points to verify the studies. On the other hand, this research work was conducted in the context of garment brand companies. Therefore, in future, Research on different sectors is recommended.

This article's research model was capable of explaining 64.4% of the total variance in relationship quality and 69.8% of the total variance in brand equity. In short, it can be said that the remaining 35.6% and 30.2% of the variance for the relationship quality and brand equity respectively left behind to be comprehended by other factors. This is why upcoming findings may enlarge the study on brand equity by judging other elements vital to improving brand equity such as product innovation, brand identity, brand experience, brand salience and brand community.

At last, the additional focus should be given to researching and exploring the brand equity at

cross-national validation. That's why the influence of marketing strategies (namely WOM and brand personality) on brand equity may vary depending on the cultural exercises of a definite country. Hence, precise findings should be carried out to examine the

marketing strategies that would positively impact different countries.

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# Nexus between relationship marketing and export performance of readymade garments exporting firms

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## ABSTRACT – REZUMAT

### Nexus between relationship marketing and export performance of readymade garments exporting firms

*The aim of this study to find out the impact of relationship marketing on export performance in readymade garments exporting firms of Pakistan. There is also the aim to find the mediating impact of trust between the relationship of relationship marketing and export performance. The present study aims to fill the existing gap in the literature which has been neglected in the previous studies. Data was collected from the managerial staff of readymade garments exporting firms and apply multiple linear regression. After the analysis of collected data, it was found that all the components of relationship marketing used in the study have positive and significant impact on export performance. It was also found that trust partially mediated the relationship of relationship marketing and export performance. At the end researchers recommended that this model can be used with more mediators and enhancing the sample size. It was also recommended to the management of exporting firms that they should more emphasize on trust to improve its export performance to different countries.*

**Keywords:** relationship marketing, adaptation, communication, cooperation, export performance, readymade garments

### Legătura dintre marketingul relațional și performanța la export a firmelor exportatoare de articole de îmbrăcăminte

*Scopul acestui studiu este de a afla impactul marketingului relațional asupra performanței la export în cazul firmelor exportatoare de articole de îmbrăcăminte din Pakistan. De asemenea, scopul lucrării este de a găsi impactul de mediere al încrederii între relația dintre marketingul relațional și performanța la export. Prezentul studiu își propune să umple golul existent în literatură, care a fost neglijat în studiile anterioare. Datele au fost colectate de la personalul managerial al firmelor exportatoare de articole de îmbrăcăminte și au fost aplicate regresii liniare multiple. În urma analizei datelor colectate, s-a constatat că toate componentele de marketing relațional utilizate în studiu au un impact pozitiv și semnificativ asupra performanței la export. De asemenea, s-a constatat că încrederea a mediat parțial relația dintre marketingul relațional și performanța la export. La final, cercetătorii au recomandat că acest model poate fi utilizat cu mai mulți mediatori și mărirea dimensiunii eșantionului. De asemenea, s-a recomandat managementului firmelor exportatoare să pună mai mult accent pe încredere pentru a-și îmbunătăți performanța la export în diferite țări.*

**Cuvinte-cheie:** marketing relațional, adaptare, comunicare, cooperare, performanță la export, articole de îmbrăcăminte

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## INTRODUCTION

Textiles and clothing industry are two very vital components of the economy and contribute a significant volume in Pakistan's economy. It accumulates 46% of the total industrial production and 67% of exports. Being one of the primary sectors as Pakistan is an agriculture intensive country, it employs 40 % of the country's population and supplements 10.20% to the gross domestic product. In the near past, Pakistan was once one of the top five largest row cotton-producing countries in the world but sadly exported in minimal quantity to foreign markets. The reasons for fewer exports to other counties involve high-Cost of production, Semi-skilled and semi-trained employees, technological challenges, lack of the management vision, and lack of modernization of specialized machinery. The rising cost of production plays a significant role in the development of the value chain in

global markets. Nevertheless, in the face of a recent shift in foreign markets and changing developments, Pakistan has tremendous export capacity. However, Pakistan's textiles sector needs to establish efficient manufacturing processes and cost to draw long-term buyers on foreign markets to remain competitive in global markets (Garment Industry report of Pakistan, 2017).

There was an intense economic competition between globalization and the dynamic world markets. Exports have therefore been extremely necessary not just for firm development but also for survival. The key form of internationalization for businesses is export. Exports have always been important to policymakers in terms of the allocation of international capital, work growth, and development [1]. Therefore, scholars and practitioners have gained significant attention in the fields of international marketing, production, and

assessment of export performance. Many studies studied a range of different determinants of export performance [2]. Traditional indicators, including management, market, and environmental factors, have contributed to the success of exports.

Nonetheless, cooperation with market growth and enhanced competition became increasingly important, and trade ties have become the central concept of the development and preservation of export ties [3]. Throughout the developing sector, scientists have paid close attention to the factors and consequences of marketing relationships. Effective communication is limited since helping an established client is simpler than recruiting new clients [4]. Improved collaborations to show beneficial results are the foundation for similar study outcomes [5]. Rambocas et al. [5] noted the mediation impact on customer satisfaction of the aspects of operation and goods of the company relationship, but this was focused on evidence from both the industry and consumer industries. The problem arises, however, how the aspects of the corporate relationship contributing to strong customer satisfaction vary between the service industry and the manufacturing sector. Various forms of customer loyalty (i.e., attitudinal loyalty and behavioural loyalty) are expected to emerge from different aspects of company relationships. Limited exposure has been given to shifts in linkages between measurements in various partnership times, the presence of which has been suggested by Rambocas et al. [5] through corporate research surveys, confidence has been found to have beneficial effects on customer partnerships. It is considered to be an asset in the measurement of partnership efficiency. It analysed the various viewpoints of the business relationship aspects (i.e., commitment-interest, reliance, transaction cost economics, and relational norms) and showed that confidence, loyalty, and relationship-specific expenditure were core drivers of business relationship success. Diamantopoulos and Winklhofer [6] defined dedication as a particular contribution or feedback into a partnership and introduced three distinct principles of engagement, attitudinal or relational dedication, functional commitment, and temporal dedication. The first is based on expectations, and the second is focused on real inputs. Short engagement implies that the partnership can continue over time.

In a meta-analysis of the empirical studies on this topic, Leonidou et al. [7] also found a positive relationship with performance. International business literature marketing ties, especially consumer internationalization policies and export knowledge, were extensively analysed and recorded [8]. The central principle of link marketing lies in the complicated and dynamic phase of internationalization of companies. Businesses, in particular those with low resources and experience, are looking for how to navigate this competitive environment in their early stage of internationalization. The usage of marketing partnership asymmetry is also essential to exporters in a general sense in order to minimize risks and increase the performance on the export market. The beneficial effect

on the export success of partnership marketing as demonstrated by extensive scientific data [9].

Current theories of export actions have indicated that internationalization will take place in phases. This method indicates that companies, particularly those with capital constraints such as small and medium-sized businesses, are slowly internationalizing, first reacting to unsolicited demands, and then experimentally exporting to physically adjacent markets to become daily exporters, then entering geographically distant markets or adopting higher entry modes. These extensions are usually defined by the wealth of companies, including experiential expertise and networks. The advent of the foreign entrepreneurship viewpoint subsequently put greater focus on the position of businesses and their capacity to push international activities. Many reports also established a shortage of internal and external capital as one of the key factors that hampered firms' success in global markets [10]. This capital constraint can be more constraining to international success as companies are subject to global business entry-related sunk costs [11]. Sunk costs can, however, influence the regularity of exports also differently. Connections have various impacts on business performance [12]. Enterprises are entering into deeper alliances that lead that better long-term interaction with their customers. Communications often play a significant role in ensuring that customers support businesses and boost their competitive advantage.

Although literature offers a wide spectrum of shared expertise, there is only a limited effect on the export success and its management implications. Generally, their immediate outcomes for export development are calculated by quantitative variables. After media models inquiries [13], numerous experiments have been performed that analyse the mediate effect of interaction variables. No agreement was achieved on variables relevant to export production. Established organizations can promote disruptive enterprise and some more severe types of unproductive entrepreneurship.

By contrast, a significant proportion of literature study was performed in the West, and work was performed in developed or mixed countries. The determiners of export success in developed world firms have also been barely discussed while the market circumstances and management characteristics of the businesses differ from the industrialized worlds.

Moreover, marketing relations between countries in developing markets are far more effective than in the USA [14]. To this end, we have looked at Pakistani prepared textile companies exporting to Europe, an exciting area not yet addressed that is more important for emerging markets. Investment and exports in emerging economies have increased, especially in Europe. Growing business relationships is important in Asian communities. Thus, understanding the role of relational variables in export success in developing countries is extremely significant. The goal of this survey is to resolve these gaps by developing and

testing a model that assesses the effect of export performance variables on developed countries.

## LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The definition of the building has not been widely accepted [15], despite the number of studies concerned with the export outcomes. Foreign markets have become more feasible and desirable targets for growth-focused domestic businesses through globalization and innovation. Export marketing policy, management, and other information in the business, sector, commodity, and export demand are among the main performance factors strongly illuminated. Older reports viewed exports purely as a means of meeting the company's economic objectives. Sales or profits have been measured with no deliberate intention to link performance to the strategic and competitive objectives of an enterprise, for example, gaining footholds in foreign markets and neutralizing competitive pressure on the company in the domestic market. Besides, these studies have shown that export output is specifically influenced by the factors business, commodity, sector, and export demand. It was not stressed the central position of the constructive marketing strategy in deciding export efficiency. As a result, exporting research is more and more isolated, and the research consists of an autonomous "mosaic". The dynamic structure is widely accepted that test preference relies on context, in particular, how the research is performed, its precision, and the viewer's goal [16]. Their preference for measurements is dependent upon qualitative criteria. Sousa [17] acknowledged that the export success requirements could be separated into objective and arbitrary metrics in a systematic literature review. Eleven are quantitative, and thirty nine are subjective among the 50 metrics for results. The outcomes of the latest investigation of both objective and subjective metrics of progress were reliable. Sousa [17] also spoke about a variety of explanations why academics prefer to use subjective rather than quantitative steps. Shoham [18], for his part, took another step by recommending the use of various indicators for better results. Katsikeas et al. [19] have carried out a thorough review of this subject in order to analyse and evaluate over 100 papers in the associated empirical studies. The analysis of its key determinants is another important research path for the field of export performance. For instance, a detailed model would be built to show potential comparative advantages, the usage of marketing methodologies, and the contribution to exports. In the same way, Morgan et al. [20] suggested an integrative theory that provides empirical support to a variety of past export projects. Marketing partnerships have a wide range of components. The variables were grouped mainly in two categories: relational (adapting, cooperation, communication) and relational (trust and commitment) contextual variables. We present in this study a model in which output variables relate to the results

of the partnership. Trust is the biggest goal to be obtained by businesses and is key to growth. We were assured that the partnership literature is recognized as a significant framework [3]. Such factors typically have long-lasting impacts on businesses and are built over time. We also included them in our definition as mediators. Our first hypothesis is the trust effect on a willingness to rely on an exchange partner that has faith in context variables. Zou et al. [21] announced that confidence takes place whenever a party values its interchange partner integrity and dignity. Within this portion, we establish a sub-hypothesis about the effect of the background variable.

*H<sub>1</sub>: Relationship Marketing has significant impact on Trust*

The emphasis on adaptation is on reacting and modifying products, processes, and solutions to these demands from the organization. The market climate recently shifted drastically, making it extremely necessary for businesses to survive and to respond to consumer shifts. While it focuses on the alteration of material, it can be changed in other sectors, including meat, electronics, etc. This sends a warning to a friend that in an international world of multiple discrepancies and unease, a strong and especially significant institution remains [22]. Effective versatility allows corporations to establish more intimate partnerships with their customers. However, work on the change of outcomes is inconsistent. The findings from d-detriment and marginal effects have had a substantial influence. However, adaptation is seen as a cornerstone of confidence [23]. While deciding, the consumer depends more on the retailer, which is pricey. Adaptation needs energy and commitment, giving a message of confidence. In short, adaptation helps develop partners' trust.

*H<sub>1a</sub>: Adaptation has significant impact on Trust*

Cooperation is the second dimension of our philosophical systemic study. Organizations function together to enhance their performance in an increasingly competitive society. Cooperation is a process in which couples operate together to accomplish shared goals. Cooperation establishes alliances between organizations for mutual purposes. The mutual relationship is part of the sharing and preservation of knowledge [24]. It strengthens coordination between the groups. Innovatively as through success expectations, teamwork also improves business income. If partners cooperate more, they know more about each other. This is a challenge to trust, knowledge asymmetry. Confidence and collaboration were then formed. Amjad et al. [25] study identified a significant shift in partners' commitment and confidence. Contrary to the partnership which encourages trust-based cooperation, more research is needed because it is not quite obvious how such variables affect each other. We assume that establishing confidence requires more time than opening up collaboration. We, therefore, propose confidence as a variable relation result dependent on the partnership, since collaboration among partners helps companies to

know each other better, and it is important to create trust between businesses:

*H<sub>1b</sub>: Cooperation has significant impact on Trust*

The connection is also a history that is regarded as important for the development and sustainability of relationships. The act of sending a message to another party is described as human action in order to communicate the message meaningfully [26]. Throughout all relationships, cooperation is essential in that it facilitates the sharing of information and dispute resolution. She has also served as a trustee delegate. Knowledge asymmetry poses a challenge in the export partnership since participants with different contexts are usually at risk of acting opportunistically. It is dangerous to create confidence if couples do not learn much about each other. Partners know each other's goals, tools, and expertise by good contact. This increasing asymmetry and vulnerability to knowledge lead to increased trust.

*H<sub>1c</sub>: Communication has significant impact on Trust*

Confidence for exporting businesses is critical in the foreign business setting, despite the volatility and confusion. The domestic industry is more dynamic, more competitive, and significant for the analysis of international firms, compared to internal links with varying levels that affect confidence between parties [27]. Scientists in this area have become rather sensitive to trust and a critical part of the process of Uppsala internationalization. Exporters are confronted by a sense of knowledge asymmetry and opportunism, and trust is one form of mitigating such menaces. The opportunity to track and control opportunistic activities decreases partner trust, which improves partners' engagement and decreases the frequency of distress. Via faith-builders, contracts such as large-scale administrative recruiting are reduced [28]; an organization can take more risk in selling relationships with a strong degree of trust. Confidence also improves the exchange of information among partners. We suggest a positive impact on export production in each of these statements.

*H<sub>2</sub>: Trust has significant impact on Export Performance*

Literature extensively researched marketing relationships, with collaborations identified as key business resources in many studies. Relations like responsiveness, contact, engagement, trust, and teamwork are analysed according to their effect on the company's results, and some studies take the findings implicitly rather than explicitly into consideration. Models of faith and devotion were developed by Sarfraz et al. [30] as intermediaries, but not always partnership variables. Nonetheless, the research does not settle about how relationship factors are transferred. As previously stated, we try a comprehensive model where trust and commitment are the key mediators in partnership marketing and, as we suggest, display the export results as follows.

Confidence is a key factor in export production, as stated in the previous section. Organizations want their spouses to have some sort of partnership. Some variables in the connection context, such as

openness, cooperation, and collaboration, resulting in confidence formation between partners and organizations, whereas reduced costs and synergies are significantly improved my confidence. Several researchers have shown confidence as a mediator in relationships of commitment and cooperation, while others say confidence leads to commitment [31]. In summary, the trust position is seen in combination with export performance.

The central issue is an organization's perception of potential partner activities and the partner's conduct. This belief comes from multiple ways of information exchange and relationship. They assume that tolerance, teamwork, and coordination relate to the confidence-building variables. When partners, there is no deception, and confidence is built up as a response to these relational variables [32]. So, we say that trust is driven by specific contextual variables and has a positive impact on export success:

*H<sub>3</sub>: Trust mediates the relationship of Relationship Marketing and Export Performance*

*H<sub>3a</sub>: Trust mediates the relationship of Adaptation and Export Performance*

*H<sub>3b</sub>: Trust mediates the relationship of Cooperation and Export Performance*

*H<sub>3c</sub>: Trust mediates the relationship of Communication and Export Performance*

## MATERIALS AND METHODS

Current study was conducted in Pakistan because readymade garments export is one of the largest export sectors of the country. This research is quantitative in nature and a well-structured adapted questionnaire was designed to collect the primary data from managerial level staff of those firms which are exporting readymade garments to different countries. The selection of firm is based on criteria that it should have more than fifty employees. Questionnaires were sent to managers of the firms through electronic mail and asked them to fill these questionnaires within two weeks. Two hundred questionnaires were delivered to the managers of those firms which fulfil our criteria. After two weeks 190 questionnaires were received from which fifteen questionnaires found incomplete and excluded from final sample. After this, 175 valid and complete responses were added for analysis. Response of the respondents was judged on five-point Likert scale which was consist 1 for strongly disagree and 5 for strongly agree. The items of the questionnaire were already used and having strong reliabilities in context of Pakistan as well as other countries, sources of these items are mentioned in table 1. For the purpose of data analysis Statistical Package for the Social Sciences (SPSS) have been used.

## RESULTS

To check the relationship adaptation, communication and cooperation on export performance multiple linear regression was performed. After the analysis it

Table 1

MEASURES USED FROM EXISTING STUDIES				
Sr. no.	Construct	Items	Reference	Cronbach's $\alpha$
1	Adaptation	5	[13]	0.80
2	Communication	4	[18]	0.90
3	Cooperation	6	[24]	0.87
4	Trust	6	[25]	0.85
5	Export Performance	4	[27]	0.81

was found that the model was significant as ( $p < 0.01$ ) and the value of F-statistics is 59.90. The coefficient of determinants ( $R^2$ ) value is 0.478 which shows that 47.8% change in export performance is due to these three independent variables (Adaptation, Communication, Cooperation) rest of change may be due to other variables which are not included in the model (table 2).

Furthermore, the results of multiple linear regression show that all three variables have significant and positive impact on dependent variable as  $p < 0.05$ .

Table 2

REGRESSION RESULTS	
Model Variable	Standardized $\beta$
Adaptation	0.333**
Communication	0.303**
Cooperation	0.395**
Trust	0.414**
F	59.90**
$R^2$	0.478
Adjusted $R^2$	0.472

The standardized coefficient ( $\beta$ ) for each independent variable is adaptation (0.333), communication (0.303) and cooperation (0.395) show that all independent variables have positive and significant impact on export performance.

### MEDIATION ANALYSIS

Mediation analysis has been performed to check the mediation effect of trust between independent variables (adaptation, communication, and cooperation) and the dependent variable (export performance). Analysis shows that total effect (0.362) with direct effect (0.339) and indirect effect is (0.313) of independent variable adaptation and dependent variable export performance while trust mediates their relationship along with ( $p < 0.05$ ). Between lower confidence level and upper confidence level there is no zero exists so it confirms that trust mediates the relationship of adaptation and expert performance (table 3). Sobel's test value ( $z=5.05$ ) also confirms the mediation. Similar results also present that trust mediates the relationship of communication and export performance and Sobel's test also confirms mediation ( $z=5.27$ ) and trust also mediates the relationship of cooperation and export performance ( $z = 4.97$ ).

### DISCUSSION AND CONCLUSION

The main purpose of current study is to find the impact of relationship marketing on exporting performance of readymade garments exporting firms of Pakistan. Additionally, the mediating role of trust is also under the consideration. Findings of the study revealed that all the hypotheses found positive and significant to which shows the relationship of variables.

First, under sight study shows the relationship between adaptation and trust in the context of Pakistani textile readymade garments exporting

Table 3

MEDIATING EFFECT					
Adaptation → Trust → Export Performance	Effect	L.C.L	U.C.L	S.E	P
Total effect	0.362	0.307	0.455	0.041	0.000
Direct effect	0.339	0.311	0.540	0.033	0.000
Indirect effect	0.313	0.310	0.415	0.023	-
Sobel's Test Z = 5.05					
Communication → Trust → Export Performance					
Total effect	0.532	0.439	0.369	0.051	0.000
Direct effect	0.327	0.274	0.465	0.047	0.000
Indirect effect	0.353	0.583	0.362	0.045	-
Sobel's Test Z = 5.75					
Cooperation → Trust → Export Performance					
Total effect	0.342	0.439	0.541	0.033	0.000
Direct effect	0.256	0.292	0.432	0.028	0.000
Indirect effect	0.339	0.342	0.307	0.057	-
Sobel's Test Z = 4.97					

firms. After analysing it was found that the impact of adaptation on trust is positive and significant. Results of this study are also supported by the results of previous study which was conducted by Shoham [18]. Results explain that adaptation is very important component to develop trust when a firm exports garments to different countries. Hence, trust leads to enhance the export performance of the firm.

Second, the purpose of this study is to find the relationship between communication and trust in the readymade garments exporting firms of Pakistan. Results of the study express that communication plays a vital role to develop the trust of the customers. Similar findings were also presented by Mattoussi and Ayadi [11] previously in their study. These results prove that better communication to the clients leads to develop trust towards firm and this trust helps to improve the export performance of that firm. An exporting firm should communicate with its clients in proper way so that firm can get long term benefits and enhance its performance in exporting of readymade garments.

Third, this study examines the role of cooperation to develop trust in the readymade garments exporting firms in Pakistan. Similar results were also presented by Lengler et al. [13] Earlier in their studies.

Cooperation is much more element to develop and enhance the trust level of clients the exporting firms as the clients look for better and quick cooperation from the firms. So, firms should be more cooperative and dynamic when they are exporting its products especially the readymade garments.

Fourth, the aim of this study is to analyse the mediating role of trust between adaptation, communication and cooperation. Outcomes of this study show that trust partially mediates the relationship of these

three elements of relationship marketing. These results are supported with the findings of Dunnan et al. [22] previously they also presented similar results in their studies. Along with the relationship marketing it is more important to develop trust firm from the clients which will leads to enhance the export performance of the firms in the field of readymade garments.

## LIMITATIONS AND FUTURE RESEARCH

This study has many valuable contributions in the current literature. Along with the contributions there are also some limitations of the study which are necessary to discuss here. First of all, the sample size of the present research is low and is limited up to the export of readymade garments only so it does not show the overall picture of export sector. Secondly this research is based on empirical nature and the authors of this research are full time scholars so it is not possible for them to spend a huge time to collect data by visiting one by respondent. So, the lack of time and resources there are possibilities that respondents may not fill the questionnaires by full attention. Despite the contributions of this study into the existing literature there are many aspects yet to discuss for future studies so that the deficiencies in the literature can be covered. Future researchers can be enhancing the sample size and it can be applied other sectors irrespective of textile sector.

Furthermore, it can be added another mediating variable like commitment to measure relationship marketing and its impact on export performance.

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# Accidentally ingested textile foreign bodies, a cause of gastrointestinal obstruction in dogs and cats – a retrospective study

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## ABSTRACT – REZUMAT

### Accidentally ingested textile foreign bodies, a cause of gastrointestinal obstruction in dogs and cats – a retrospective study

*Gastrointestinal obstruction is a life-threatening condition that is usually caused by accidental ingestion of inedible objects, through play or food indiscretions. Ingested foreign objects generate the mechanical obstruction of the gastrointestinal segment, characterized by a relatively typical set of symptoms, depending on the location. The aim of this study was the clinical and imaging description of some cases of gastrointestinal obstruction in dogs and cats, caused by swallowing textile foreign bodies. The study included 12 dogs and 8 cats of different breeds and ages, belonging to both sexes, which showed clinical signs suggestive from a clinical-anamnestic point of view for gastrointestinal obstruction. These patients had symptoms with acute or chronic progressive evolution of the gastrointestinal tract, including restlessness, deviation, vomiting (single or repeated episodes), abdominal tenderness, constipation and tenesmus. The diagnosis was confirmed by radiographic examination, simple and with contrast medium, and ultrasound, completed in some situations with laparotomy. Ingested textile foreign bodies were represented by socks/stockings (5 dogs and 3 cats), underwear (3 dogs), rope (1 dog and 3 cats), carpet fragments (2 dog and 1 cat), toy fragments (1 dog and 1 cat), and they were located in the stomach (7/12; 58.33%, respectively 4/8; 50%), in the gastro-duodenal segment (2/12; 16.67%, respectively 3/8; 37.5%), in the jejunum (3/12; 25%, respectively 1/8; 12.5%) and in the colon (1/12; 8.33%, respectively 1/8; 12.5%). Gastrointestinal obstruction in pets, caused by accidental ingestion of textile foreign bodies, is a medical emergency and imaging examinations are the main diagnostic tool in the establishment of a subsequent therapy with maximum efficiency.*

**Keywords:** cat, dog, foreign bodies, textile

### Corpuri străine textile ingerate accidental, cauză de obstrucție gastrointestinală la câini și pisici – un studiu retrospectiv

*Obstrucția gastrointestinală este o afecțiune care poate pune viața animalelor în pericol, obișnuit cauzată de ingestia accidentală a unor obiecte necomestibile, din joacă sau din cauza indiscrețiilor alimentare. Obiectele străine ingerate produc obstrucția mecanică a segmentului gastrointestinal, caracterizată de un ansamblu simptomatologic relativ caracteristic, în funcție de localizare. Scopul acestui studiu a fost descrierea clinică și imagistică a unor cazuri de obstrucție gastrointestinală la câine și la pisică, determinată de înghițirea corpurilor străine de natură textilă. În studiu au fost incluși 12 câini și 8 pisici de rase și vârste diferite, aparținând ambelor sexe, care au prezentat semne clinice sugestive clinico-anamnetice pentru obstrucția gastro-intestinală. Acești pacienți au prezentat simptome cu evoluție progresivă acută sau cronică ale tractului gastro-intestinal, incluzând neliniște, abateri, vomă (unică sau repetată), sensibilitate abdominală, constipație și tenesme. Diagnosticul a fost confirmat prin examen radiografic, fără și cu mediu de contrast, și ecografic, completat în unele situații cu laparotomie. Corpuri străine textile ingerate au fost reprezentate de șosete/ciorapi (5 câini și 3 pisici), lenjerie de corp (3 câini), sfoară (1 câine și 3 pisici), fragmente de covor (2 câine și 1 pisică), fragmente de jucării (1 câine și 1 pisică), iar localizarea lor a fost înregistrată la nivelul stomacului (7/12; 58,33%, respectiv 4/8; 50%), gastro-duodenal (2/12; 16,67%, respectiv 3/8; 37,5%), jejunului (3/12; 25%, respectiv 1/8; 12,5%) și colonului (1/12; 8,33%, respectiv 1/8; 12,5%). Obstrucția gastrointestinală la animalele de companie, cauzată de ingestia accidentală a corpurilor străine de natură textilă, reprezintă o urgență medicală, iar examenele imagistice reprezintă principalul instrument de diagnostic în orientarea terapeutică ulterioară cu maximă eficiență.*

**Cuvinte cheie:** pisică, câine, corpi străini, materiale textile

## INTRODUCTION

In veterinary practice, accidental ingestion of foreign bodies is one of the causes leading to medical visits [1–4]. This phenomenon is reported incidentally after ingestion during play or due to food indiscretions, being encountered in both young and adult animals [1]. Ingested foreign bodies can pass through the

digestive tract without causing any damage, patients remaining asymptomatic, but large and irregularly shaped foreign bodies can hinder the digestive transit and may cause partial or total obstruction [2, 3, 5]. Mechanical gastrointestinal obstruction is a life-threatening condition and it is characterized by a relatively typical set of symptoms, depending on the



location and type of the ingested foreign body [1, 2, 6]. These bodies can vary in nature, including among their ranks bones, stones, wood, leather, fruit kernels, metals, plastics, but also textiles (non-linear and linear) [3, 4, 7]. Romania is one of the largest textile producers, supplying on the clothes market, the carpet market, and the market of textiles and fibres used in various economic sectors [8]. The aim of this study was the clinical and imaging description of some cases of gastrointestinal obstruction in dogs and cats caused by swallowing textile foreign bodies.

## MATERIALS AND METHODS

A retrospective analysis was performed based on the synthetic evaluation of the medical records of the patients visiting in the Clinic of the Faculty of Veterinary Medicine in Bucharest, displaying suggestive signs for gastrointestinal obstruction during 2019–2021. Patient identification data (dogs and cats) were obtained, including breed, age and sex, as well as the medical history and clinical signs displayed. Patients who received a clinical examination supplemented with an abdominal imaging examination, represented by radiographic examination (using a DuraDiagnost F30 machine, Philips, China) and/or ultrasound examination (using a MyLab Six, Esaote, UK device) were included in the study. In some situations, contrast radiography was used to confirm the

diagnosis of gastrointestinal obstruction, obtaining multiple images, orthogonally, at appropriate time intervals, according to classical protocols [9].

Depending on the signs expressed by the patients, respectively on the location of the gastrointestinal obstruction as established by the imaging examination, they were referred to a medical treatment (purging, enema or inducing vomiting) or to surgery. The Surgical treatment was performed on anesthetized patients, using, as appropriate, laparoscopic-gastrointestinal enterotomy and/or enterectomy in accordance with existing protocols [10, 11].

## RESULTS AND DISCUSSIONS

The current study included 12 dogs and 8 cats, of different breeds and ages, belonging to both sexes (table 1), which displayed clinical signs of gastrointestinal obstruction.

For 9 dogs and 7 cats, the owners provided information on the textile nature of the ingested objects because they observed the animals playing with them and later discovered the items missing, while for the rest of the animals (3 dogs and 1 cat), the owners were unable to provide any data on the possible ingestion of foreign bodies. During the clinical examination, the animals displayed gastrointestinal symptoms with acute or chronic progressive evolution, identified as restlessness (8 dogs and 6 cats),

Table 1

PATIENTS INCLUDED IN THE STUDY					
No.	Breed	Age (months)	Sex*	Identified foreign body	Localization
<b>Dogs (no.=12)</b>					
1	Crossbreed	72	m	Sock	stomach
2	Cocker spaniel	36	f	Stocking	jejunum
3	Crossbreed	120	f	Underwear	stomach
4	Crossbreed	42	f	Toy fragments	stomach
5	French Bulldog	36	m	Stocking	stomach & jejunum
6	Bichon	132	m	Underwear	gastro-duodenal segment
7	Crossbreed	7	m	Rope	gastro-duodenal segment
8	Golden retriever	54	m	Carpet fragments	jejunum
9	Basset	84	f	Underwear	stomach
10	Bichon	24	m	Sock	stomach
11	German Shepherd	36	m	Carpet fragments	colon
12	Boxer	24	f	Sock	stomach
<b>Cats (no.=8)</b>					
13	Ragdoll	36	m	Toy fragments	stomach
14	European shorthair	48	m	Sock	stomach
15	European shorthair	108	f	Rope	gastro-duodenal segment
16	Persian	84	f	Carpet fragments	colon
17	Persian	96	m	Sock	stomach & jejunum
18	European shorthair	22	m	Rope	gastro-duodenal segment
19	European shorthair	14	f	Sock	stomach
20	Siamese	24	m	Rope	gastro-duodenal segment

Note: \* m = male; f = female.

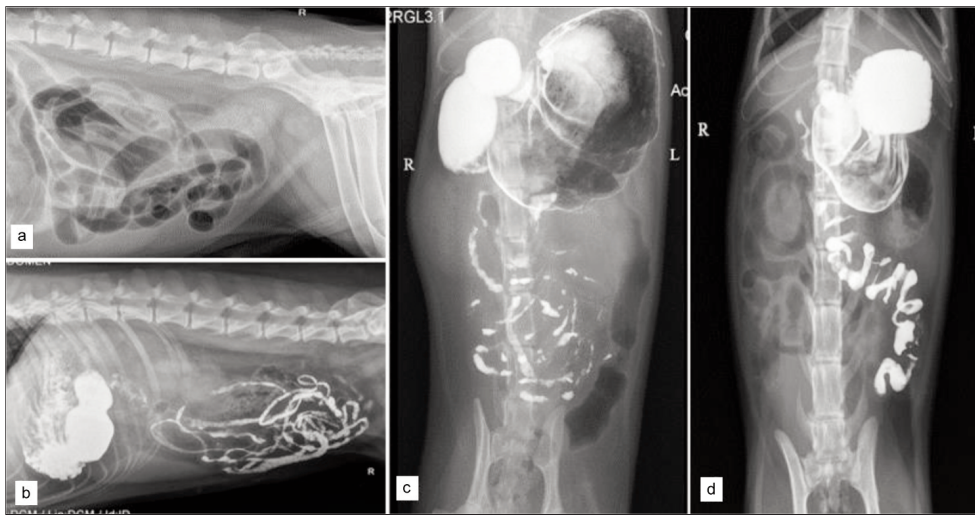


Fig. 1. Simple radiographic examination with contrast medium of the abdomen: *a* – right side view, showing gas-dilated intestinal loops and an area with high density, inhomogeneous, in the terminal part of the colon (textile foreign body and dehydrated feces) (case 11); *b* – right lateral view and *c* – ventro-dorsal view, with contrast medium showing gastric dilation and the persistence of the contrast substance at the level of the pylorus (non-linear textile foreign body) (case 6); *d* – ventro-dorsal view, with contrast medium showing the pleated duodenal segment (linear foreign body) (case 15)

deviation (4 dogs and 2 cats), vomiting (unique episodes in 3 dogs and 2 cats, and repeated episodes in 9 dogs and 5 cats), distension and abdominal tenderness (3 dogs and 2 cats), constipation and tenesmus (2 dogs and 1 cat). To confirm the diagnosis of mechanical gastrointestinal obstruction, simple abdominal radiographs were performed on all animals, aiming at the discovery of gastrointestinal changes, such as mechanical ileus (figure 1, *a*), but these were not always conclusive. Therefore, other diagnostic methods were used, such as radiographic examination with contrast medium, obtaining a series of images from the left side, right side and with ventro-dorsal

view, according to previous indications [9]. Thus, changes and radiographic signs were observed that confirmed the presence of foreign bodies in the gastrointestinal segment, including delayed emptying of the stomach (9 dogs and 8 cats) and the presence of thin post-obstruction contrast medium (6 dogs and 5 cats) (figure 1, *b* and *c*), the pleating of the intestinal loops in the proximal intestinal segment (1 dog and 3 cats) (fig. 1, *d*), or the blocking of the intestinal contrast medium (3 dogs and 2 cats). In addition, the ultrasound examination, performed on 6 dogs and 5 cats, showed pyloric obstruction (3 dogs and 3 cats), segmental intestinal dilation (2 dogs) and the pleating of bowel loops (1 cat), and for the rest of the patients (1 dog and 3 cats). 1 cat the signs were inconclusive. Following the clinical and imaging examination, it was possible to locate the foreign bodies along the gastrointestinal tract: at the level of the stomach (7/12; 58.33%, respectively 4/8; 50%), in the gastro-duodenal segment (2/12; 16.67%, respectively 3/8; 37.5%), in the jejunum (3/12; 25%, respectively 1/8; 12.5%) and in the colon (1/12; 8.33%; respectively 1/8; 12.5%). It should be noted that, in a dog and a cat, foreign bodies were present in both the stomach and the jejunum. In the case of 2 dogs (case 1 and case 10), because the owners immediately went to the clinic with the animal and were able to provide information about what had happened before (ingesting a baby sock), they resorted to inducing vomiting, the animals being able to eliminate the ingested foreign body. Also, one cat (case 13), which came to the clinic with repeated vomiting, spontaneously vomited fragments of a textile toy after the clinical examination, and the radiographic images obtained did not show signs of gastrointestinal obstruction. In one patient (case 11), due to the location of the obstruction in the terminal segment of the digestive tract, repeated enema and fragmentation by forceps of a “plug”, containing carpet threads mixed with dehydrated feces and dry grass threads, were used. In the other cases (9 dogs and 7 cats), the foreign bodies were removed after performing the exploratory laparotomy, gastro- and enterotomy. It should be mentioned that in case 5, due to the presence of the textile foreign body, invagination and local necrosis of the intestinal wall occurred, which required the resection of the respective segment

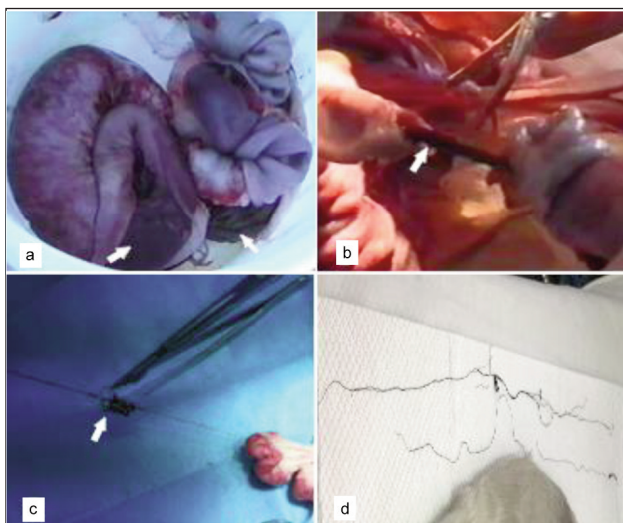


Fig. 2. Extracted foreign bodies: *a* – segmental jejunum resection following invagination caused by the presence of a sock (arrows) (case 5); *b* – non-linear textile foreign body (sock – arrow) at the intestinal level (case 2); *c* – linear foreign body (string – arrow) (case 15); *d* – rope extracted from the stomach of a Siamese cat, 2-year-old male (case 20)

(figure 2, a). Foreign bodies removed from the patients included in this study were represented by socks/stockings (5 dogs and 3 cats) (figure 2, b), underwear/panties (3 dogs), rope (1 dog and 3 cats) (figure 2, c), carpet fragments (2 dogs and 1 cat), toy fragments (1 dog and a cat) (table 1).

Pets, including dogs and cats, can accidentally ingest various objects that are not usually part of their daily diet, including inedible objects such as textiles. The ingestion of foreign bodies can occur through play, incidental in young animals due to age-specific exuberance [2, 12], but can also be found in adult animals [4]. The ingestion of textiles may also be the consequence of perverted taste [13] or their impregnation with food odours [14], as evidenced by the history of some cases in the current study. The examined patients examined were aged between 7 months and 11 years in dogs, with an average of 4.63 years, respectively 14 months and 9 years, with an average of 4.5 years in the case of cats, the results being consistent with those described in the field literature [2, 4]. Regarding the breed of animals included in the study, as shown in table 1, half-breeds (4/12; 33.33%) in the case of dogs and the common European breed (4/8; 50%) in the case of cats were the most affected. Previous studies have shown an obvious heterogeneity of the races in which accidental ingestion of foreign bodies was diagnosed [1–2, 6], and the differences may be the consequence of the different number of patients included in the study, but also of the existing population diversity.

Pathogenetic lesions are dependent on the type of foreign body accidentally ingested, linear (which remains fixed in a point of the digestive tract, causing distal intestinal folding) or non-linear/discrete (which does not cause bowel loops) [3]. The results of our investigations indicated the presence of both non-linear textile foreign bodies (91.67% of dogs and 62.5% of cats, respectively) and of linear textile foreign bodies (8.33% of dogs, respectively 37.5% of cats), similar to those previously published [2, 4, 6]. In general, foreign bodies ingested by animals and reaching the gastrointestinal tract may cause partial or total obstruction of the lumen, depending on their size [1–5, 12]. However, most of the time, the total obstruction is the result of the presence of solid foreign bodies with large dimensions and no holes, which block the intestinal transit, appearing radiographically as “filling defects” in the contrast medium column, causing dilation of the gastrointestinal segment and accumulation of the contrast substance before the obstruction [9]. In the case of textiles, the radiographic aspects are distinctly different from those found in foreign bodies of another nature, because textiles do not appear as “filling defects”, but absorb the contrast medium (acting like a sponge) which they gradually release when the peristaltic wave passes, thus determining the appearance of the post-obstruction “thin wire” contrast medium. In the current study, it was found that non-linear foreign bodies caused a relative total obstruction of the gastrointestinal lumen, while linear

foreign bodies caused folding of the affected segment. Both are typical aspects and they are highlighted accordingly on contrast radiographic images.

The clinical picture and imaging aspects are directly correlated with the time elapsed since the ingestion of foreign bodies and their location along the digestive tract [6]. For the patients included in this study, their localization is comparable to that described in some previous studies [4], but different from others [2]. It was observed that the stomach (pyloric antrum) and the gastroduodenal segment represent the main location, followed by the jejunal segment, in both dogs and cats. This can be attributed to the fact that, in most cases, patients came to the clinic immediately after the ingestion of foreign bodies, which did not migrate too much along the intestinal tract, an idea supported by the preponderance of acute clinical signs and the absence of severe complications. The ultrasound and the radiographic examinations with contrast medium, through the accuracy and diagnostic significance, constitute a true imaging method for assessing the parietal integrity, respectively the destruction of the specific parietal architecture. Although the presence of linear foreign bodies is associated with an increased rate of morbidity and mortality in patients due to the degree of compromise of the intestinal wall [2, 7], no severe changes were found in our study, which can be attributed to the rapid intervention in case management. However, in 2 cases, during surgery, jejunitis (inflammation of the jejunum wall) and invagination with necrosis of the intestinal wall were observed, which required the resection (enterectomy) of that segment.

Textiles accidentally ingested by pets are a real danger to their lives through gastrointestinal obstruction and parietal destruction. Previous studies have suggested that the severity of clinical signs and the risk of necrosis and intestinal perforation may be correlated with the type of material ingested (linear or non-linear), but also with the time elapsed from the ingestion to the medical intervention [2, 15], which requires an intervention as soon as possible to remove them. In the current study, the patients' recovery was complete, without the occurrence of secondary complications, including for those who underwent surgery.

## CONCLUSIONS

Our investigations have highlighted the involvement of a wide range of textile foreign bodies in the production of gastrointestinal obstruction, both in dogs and cats.

The incidence of ingestion of foreign bodies of non-linear textile origin was 91.67% in dogs and 62.5% in cats, all occurrences being attributed to food indiscretions.

Gastrointestinal obstruction in pets is a medical emergency, and imaging examinations are the main diagnostic tool that allows for appropriate therapeutic guidance in the effective resolution of those cases.

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