+Science of Clothing Comfort
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Lecture - 06
Psychology & Comfort (contd…)

Hello everyone. So, we will continue with the psychological scaling system. So, in last class we have discussed; there are 4 different types of psychological scaling: Nominal scale, Ordinal scale, Interval scale and Ratio scale.

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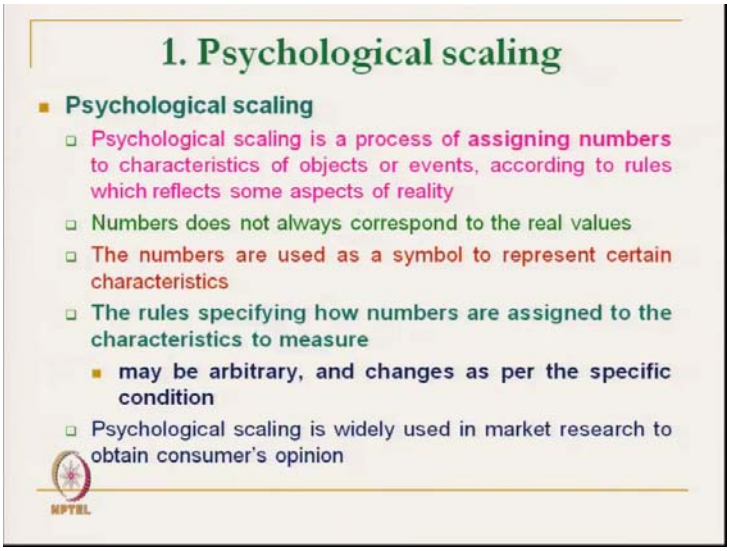

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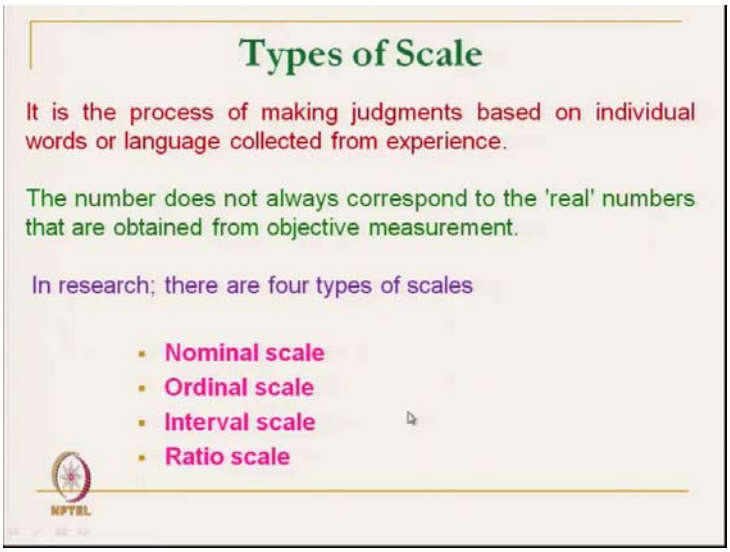

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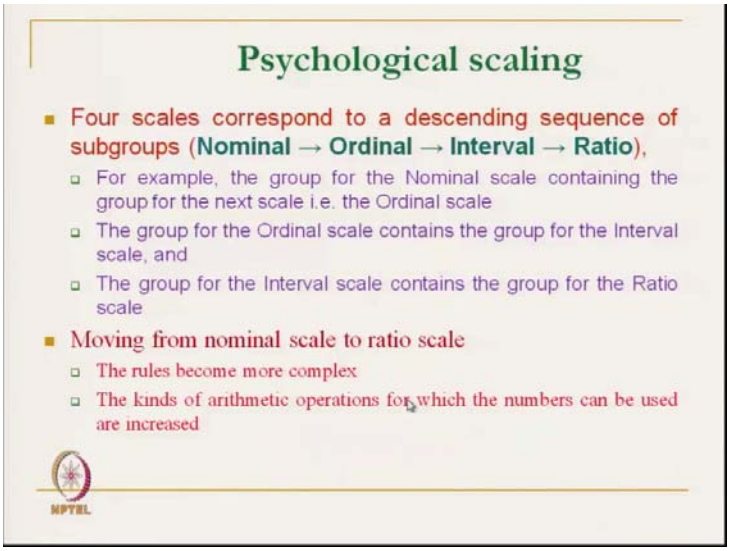

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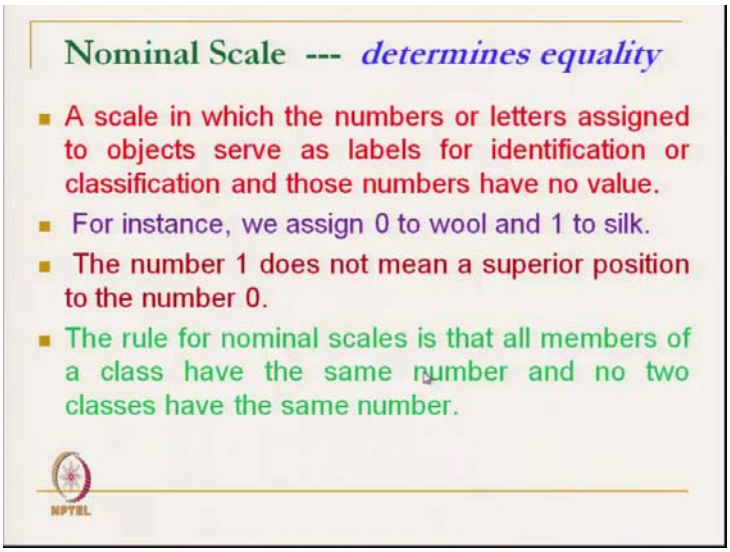

We have discussed the nominal scale which actually talks about the equality.

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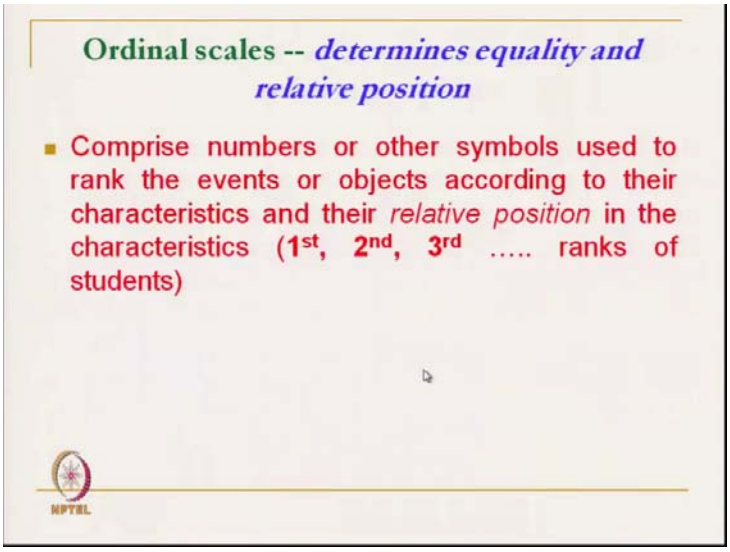

Like we have mentioned wool, if we give 0 and silk we can give 1; that means, all silk, we have to give 1 and all wool, we have to give 0; that means, 0 means equality in the characteristics. We cannot differentiate; we can only differentiate between wool and silk then we tell correct.

So, within wool, we are not able to differentiate. So, nominal scale is a very simple one. So, we just differentiate between wool and silk. So, within wool there may be 100 different types of wool, but nominal scale as we have mentioned, it is a 0 as wool; we

cannot stop there, we cannot differentiate between wool 1, wool 2, wool 3, for that, it is a next scale which is called ordinal scale.

Ordinal scale takes care of equality as well as relative position. Like equality means nominal scale; it is here just like a nominal scale. It takes care of it, separate out wool as 0 silk as 1, but within 0 within wool, it will talk about the relative position, that is the second level, like In a class say 10^{th}, class 11^{th}; 10th, we can give it as a or eleventh as b.

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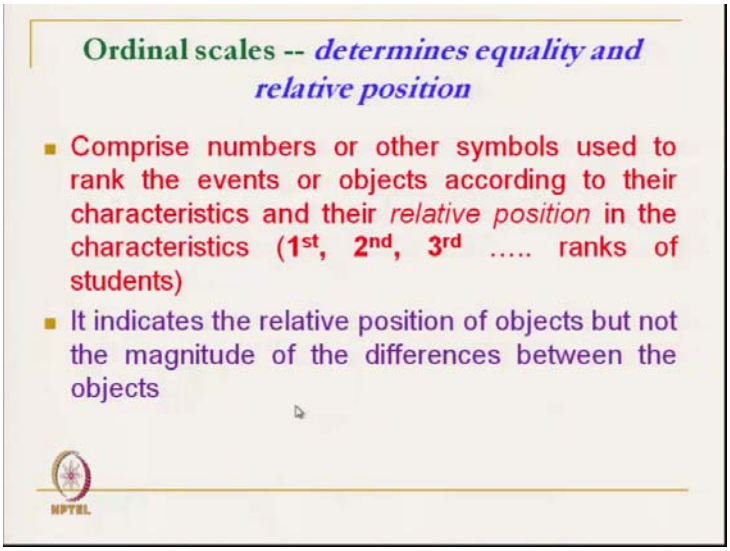

So, as per nominal scale 10th means ‘a’ but ordinal if we talk then it will actually give rank or marks; it will give you 1, 2, 3, 4, 5. So, it ranks the student; it is relative position of the student. So, this is called ordinal scale. Like, if we take the example of textile material like earlier, between wool was 0 and silk was 1.

Now, within wool, we have 10 different types of wool, we want to differentiate. So, 0 is wool then difference in terms of softness or hand feel; 0 softest, 0 harsh, like that we can rank. It indicates the relative position of the objects, as per the softness level which one is top, but the magnitude of difference of the object, we cannot measure, it is not the magnitude.

We have 3 different types of wool; wool 1, wool 2, wool 3. Wool 1 is very soft; there is a medium soft and it is a harsh, wool 3 is harsh. This much it can tell the ordinal scale. A

silk also; silk 1, silk 2, silk 3, but it cannot tell difference between wool 1 to wool 2 or wool 2 to wool 3 whether it is an equal difference, it cannot tell. How much difference it is there. So, this scale only gives the a ranking

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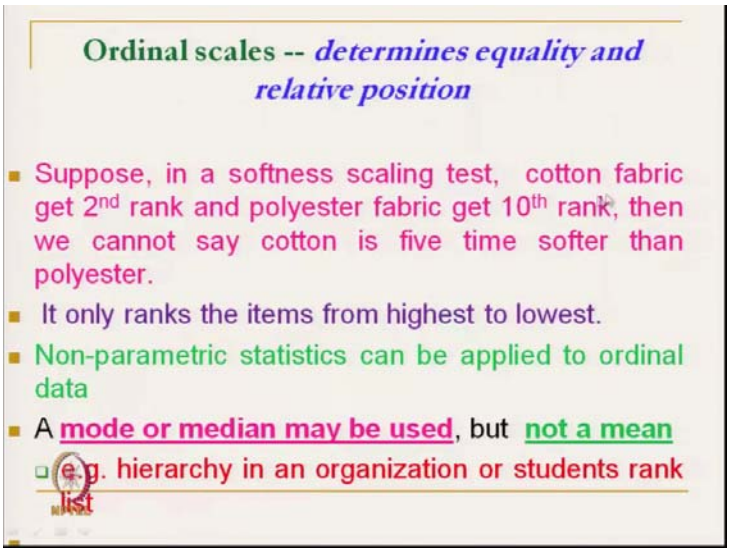

Suppose in the softness scale, the cotton gets the rank of 2nd. So, what we are doing? We are trying to rank all the available fibre in our lab. So, we have got the wool, silk, cotton, polyester. So, we are trying to rank. So, on rank scale, on the softness, the cotton gets the 2nd rank and polyester gets the 10th rank. So, as per this ordinal scale we cannot say that cotton is 5 times softer than polyester, difference it cannot say; it cannot identify the difference. It only ranks the item from highest to lowest; ranking it will give.

So, what we can do? We can actually use some non parametric statistics, what is that? Mode or median we can use, but mean we cannot; like if we want to rank which fibre is at the middle as per the softness then we cannot perform the mean value. Similarly, hierarchy in an organisation like; top president and vice president like that. We can rank it depending on the rank of the in organisation.

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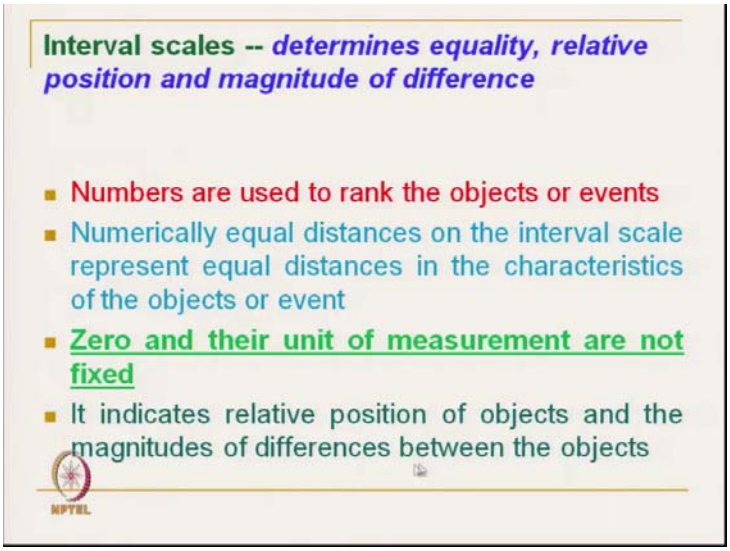

Suppose on the softness scale; what interval scale determines the equality, determines the equality like or nominal scale plus it is relative position ranking and then it talks about the magnitude of difference. It is the interval scale, it takes care of the magnitude of difference. Magnitude should be same; it will tell.

Best example is numbers are used to rank the objects or events numerically equal distance of the interval scales represents equal distance in the characteristics. So, another thing 0 is not fixed here. This has got 0 and there unit of measurement are not fixed. It indicates the relative position of the object and the magnitude of difference between the object.

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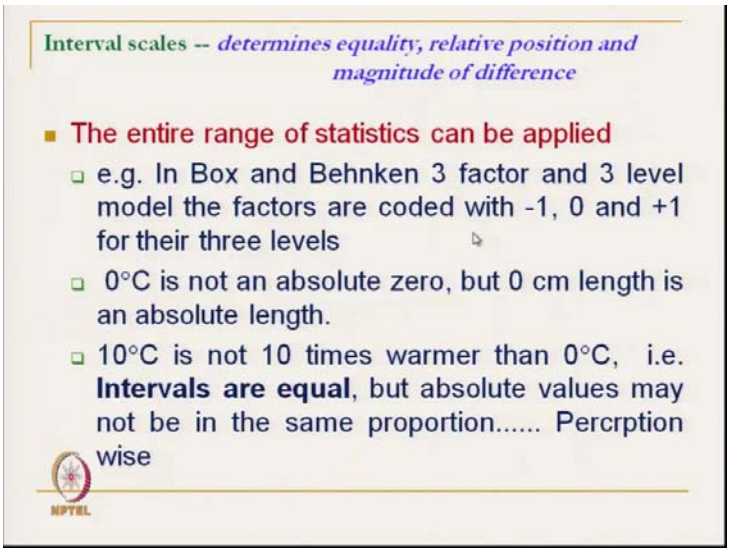

The most common example is Box and Behnken technique which we use. We use 3 factor 3 level Box and Behnken, we use the code it is a minus 1, 0 and plus 1 level. 0 does not mean it is absolute 0; it is a level, but here we can say that difference between minus 1 and 0 and 0 and plus 1 of a particular attribute is same. So, magnitude or difference is same.

Now, we can see wool fibre softness, we have measured at different level of softness, so, 20, 30, 40. So, 30 being centre code, it as 0 or we can use 20, 30, and 40. So, that way the magnitude of difference would be same, but here, one catch is there, its 0 does not mean absolute 0; 0 it is a scale factor.

For example, 0 degree Celsius is not an absolute 0, but 0 centimetre is an absolute a because, 0 centimetre length is a an absolute length, but 0 degree Celsius is not absolute 0 temperature; it is in kelvin, it is absolute. For example, if we talk about say 0 degree Celsius and say, it is not 10 times warmer than 0 degree Celsius; it is a reference and in between, but the intervals are equal. The here the intervals are equal, but no absolute value 0 value; magnitude of differences are equal. So, here 0 is not absolute. So, perception wise, we will not get 10 times warmth than 0 degree Celsius or 1 degree Celsius. So, that perception wise, it is not same.

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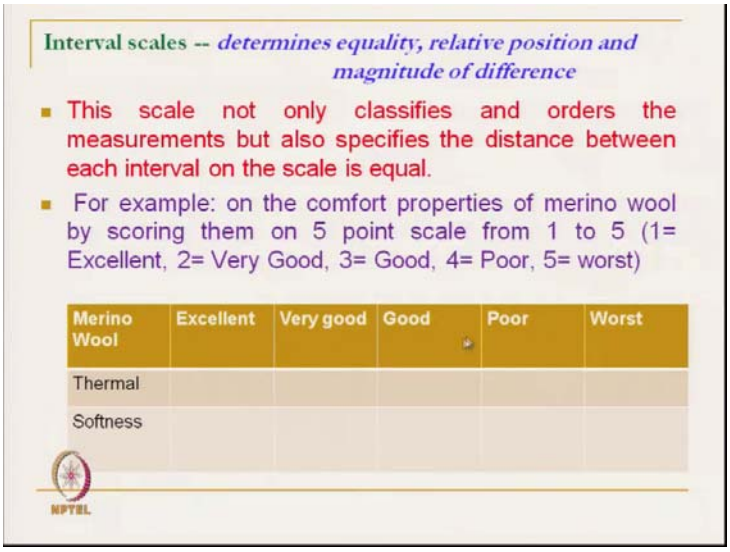

The scale is not only classified and ordered or measured, but in the order of measurement, but also specify the distance between each interval on the scale.

So, this is the thermal scale. Thermal scale; you can give excellent, very, good, poor, worst. This way we can give some particular point.

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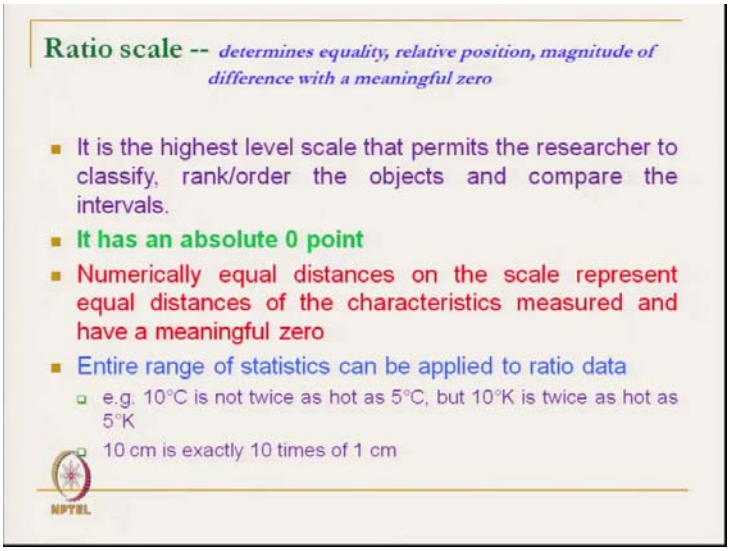

And last one is the ratio scale. Ratio scale talks about the equality, relative position, magnitude of difference and with a meaningful 0. It has to have a particular absolute 0 value like Kelvin scale. So, it has an absolute 0 value like 10 degree Celsius is not twice as hot as 5 degree Celsius, but 10 degree kelvin is twice as hot as 5 degree kelvin. So, if you have absolute 0 value, then you can compare like 10 centimetres is double to that of 5 centimetres. It has got absolute 0 value.

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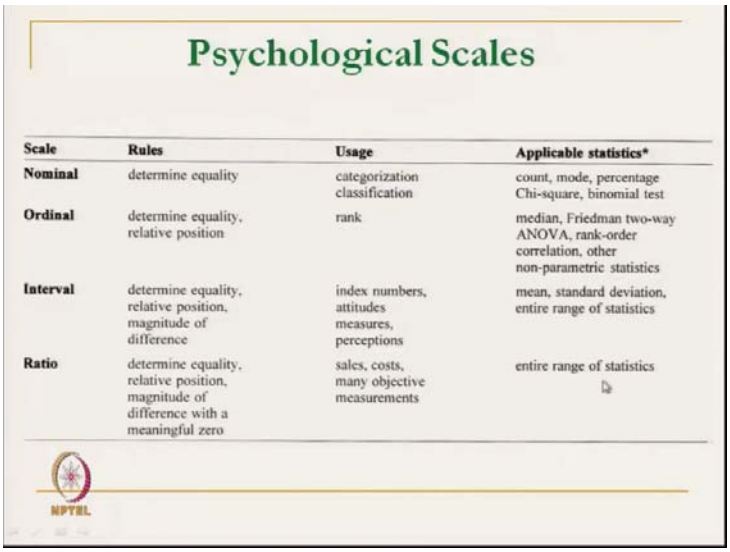

So, if we see in tabular form in totality, if you see nominal scale, it determines only the equality. It categorise and classification. It only categories wool is 0, silk it categorises. And what type of statistics we can use? We can measure the Count, mode or percentage, chi square; this type of statistics you can use.

Ordinal scale, what it determines? The equality and relative position it can rank, it can rank the objects and different types of like median, ANOVA. This types of statistics we can use. The interval it talks about the equality, relative, position, magnitude of difference and we can use it in index numbering, attitude measurement, perception measurement. So, interval you can use. Perception means it is a warmth or cold. This type of perception measurement, we use interval scale; mean, standard division, all these type of a statistical tool, we can use ratio scale. It determines the equality, relative position and magnitude of difference with meaningful 0. So, entire statistical performance we can do.

Next is that another type of scale, it talks about the rating scale and this rating scale is extensively used in market research.

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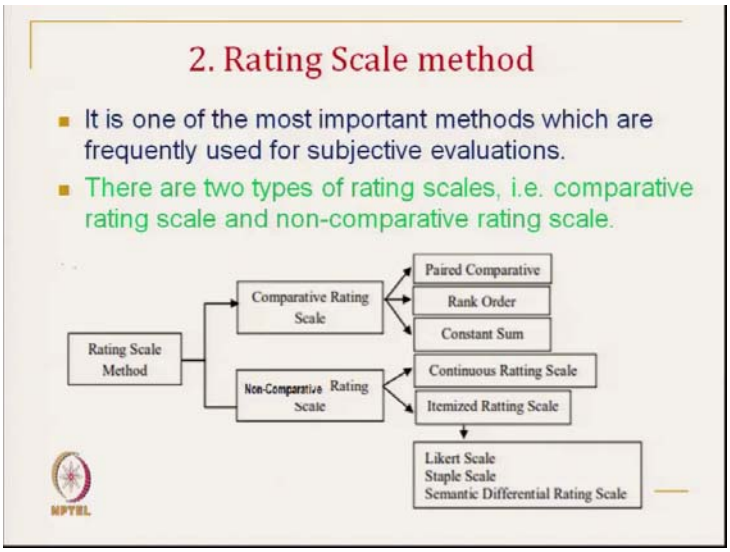

It is one of the most important method which are frequently used for subjective evaluations. There are 2 types of rating scale: one is called comparative rating scale, another is non-comparative rating scale.

Now, comparative rating scales are again subdivided by paired comparative rating scale. So, paired comparative rating scale, so what does it mean? We will have pair a, b, then we can compare. I will discuss in detail then rank order. So, we do not have the pair, we have one single item; then we can order in terms of rank order comparative rating scale. So, comparative means, we have to have more than one attribute, one object like wool. So, wool and silk; we have 2 types of fibres.

So, when there is a pair of objects. So, we can use paired comparatives like we have 10 different types of wool. So, what we will use? We will use comparative scale, but in rank order. We can order Wool 1, Wool 2, and Wool 3 depending on a different types of subjective assessment

Then constant sum; so, we have different perception and then we can add the perception values and then we can totally get the constant sum. We will discuss in detail. Then this is comparative means more than one object should be there, but non-comparative is that we have single object one particular garment and I have to actually rate; rate in terms of say thermal comfort. So, in that case we can use the non-comparatives scale. Non-comparative scale is where we have more than one object

So, non-comparative scale is a continuous rating. So, we can have a continuous scale we

can just use a particular value and itemised rating scale, non-comparative itemised rating scale is the again subdivided into 3 types: one is Likert Scale, Staple Scale and Semantic Differential rating scale. So, this we will discuss one by one

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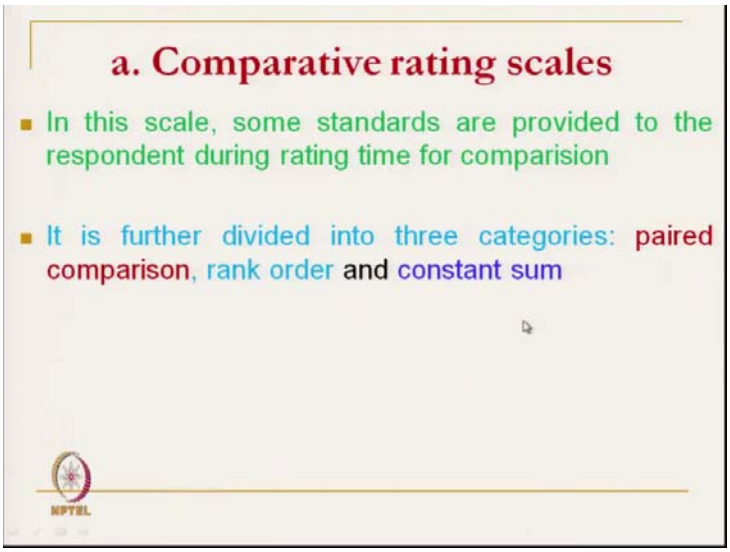

So, comparative rating scale as we have discussed it has got 2 types. In this scale some standards are provided; that means, we have to compare to the respondent during rating time for comparison. So, we have to have one standard, then we can compare

So, as we have discussed, it is a paired comparison, rank order and constant sum. So, here we have to give one standard then the respondent will give the response

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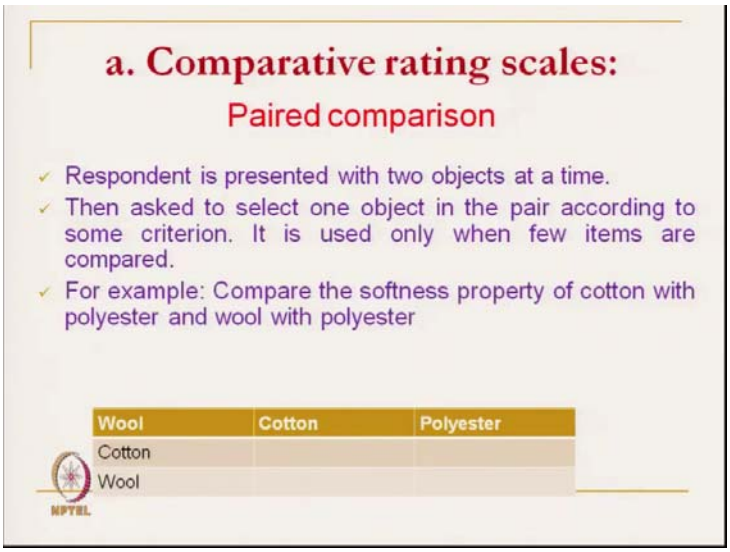

Paired comparison respondent is presented with 2 objects at a time; it is a paired of object. So, then only you will tell, this is soft, or hard.

Then asked to select one object in the pair according to some criteria like 2 garments are given, which one is warm that is paired. This used only when few items are compared. So, you cannot use this paired comparison for say large thousand different types of articles. We cannot use this type of pair, only few articles then you can compare.

For example compare the softness property of cotton with polyester or wool with polyester, then only this type of paired comparison can be used. So, and we can only tick which one is softer or which one is warmer. So, it is used only when one standard has to be given and less number of variable items should be there and you will only compare based on 2 pair.

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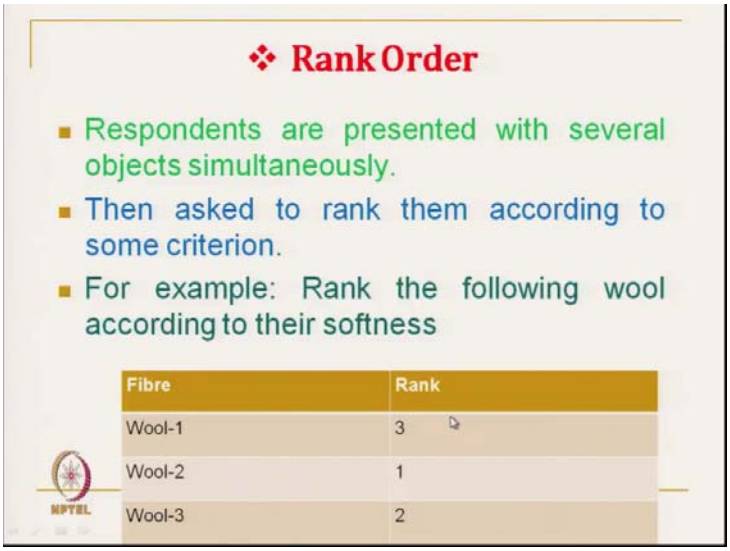

Next is the rank order, respondents are presented with several objects simultaneously like wool is given. So, 10 different types of wool or 3 different types of wool garment is given and he is asked to rank in terms of particular order, then asked to rank them according to some criteria. For example, rank the following wool according to their softness.

So, 3 different types of wools are given; wool 1, wool 2, wool 3; then he has ranked wool 1 has 3 rank softness, wool 2 has got 1 rank of softness, wool 3 has got 2. But 3, what does it mean? 3, here is it softest or harshest? It is soft or harsh that we have to actually specify; we have to tell if it is soft, very soft, you give 3 or if it is soft, very soft you give 1. So, this thing we have to give in detail that is called rank order. The respondent has to only rank different types of wool.

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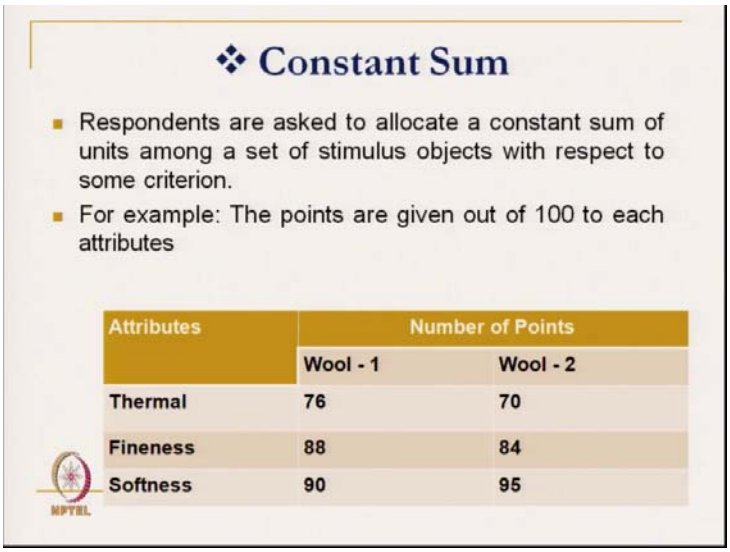

Third one is that it is a constant sum. So, what is that?

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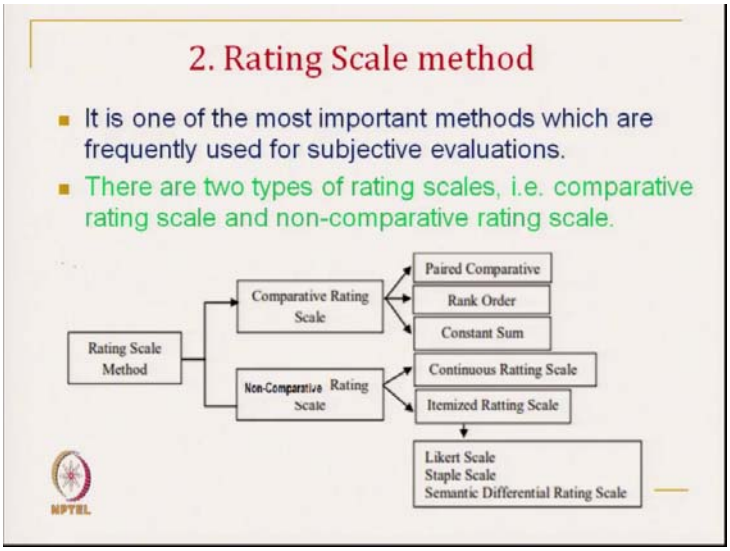

It is a comparative constants sum. So, again we are comparing with the something. Respondents are asked to allocate a constant sum of units among a set of stimulus objects with respect to some criteria. So, we have fixed some criteria.

Suppose, we have 2 different types of wool; wool 1 and wool 2. The criteria which has been actually described; you give thermal, fineness and softness, 3 criteria is explained to you and you give the rank order; you give the value out of 100. It is an arbitrary, you

give on the basis of 10 scale, if you want very detailed result or a very sensitive result. You can increase that one with the 100 scale, you rank wool 1 and wool 2 in terms of thermals; 100 means, suppose, 100 means best. So, thermal scale he has given. So, 76 for wool 1 and 70 for wool 2; fineness 88 and 84, softness 90 and 95;

Now, if we assume thermal, fineness and softness are the best parameter to judge the characteristics of wool. Then we will use 3 and if you feel some other parameters has to be incorporated, we can keep on incorporating.

Now, then we will simply add constant sum. So, what is the total value of this attributes? So, out of 300, wool 1 has got this ranking, wool 2 has got this ranking. So, then we will add these values, then we will tell wool 1 is good or bad. So, wool 1 has got say as per thermal sensation, it has got higher than wool 2, but softness got lower than wool 2. So, we cannot tell, softness wise, it is more or not. We have to add. So, then based on this addition, we can tell. So, this is called constant sum It is a comparative one; comparison between wool 1 and wool 2.

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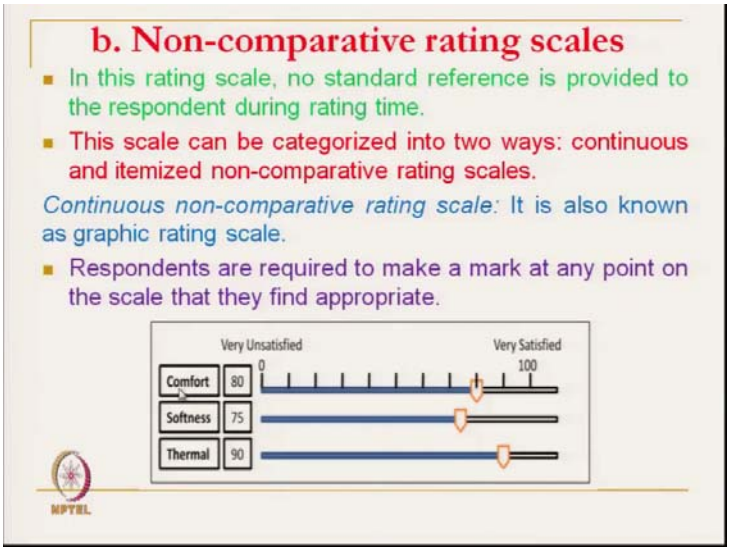

Then comes the non-comparative. Here we do not have any reference, no standard value here, what we will do? We have the single object. In this scale, no standard reference is provided for rating. This scale can be categorised into 2 ways: one is continuous, another is itemised non-comparative rating scale. So, what is continuous rating scale, it is a graphical rating scale. Continuous rating scale is also known as graphical rating scale

We want to have comfort, softness or thermal sensation for a particular garment. So actually in market research, this is very widely used and respondents are asked to actually rate to rank. In terms of comfort, you just select particular garment, you rate 80, 75, and 90. So, for even one garment you rank this thing. Accordingly it is so, and there is no comparison. So, suppose for a particular garment, we take say 100 respondent. So, they give this value then we use some statistical technique to arrive at certain value. So, this is the continuous one

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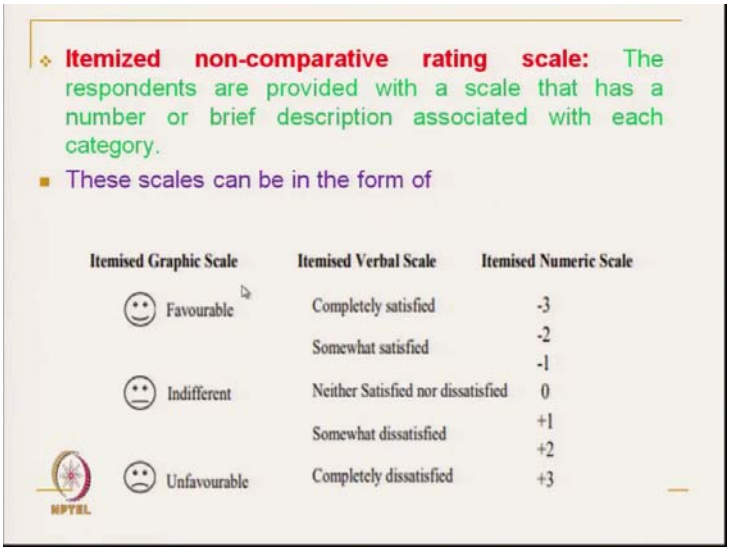

So, then come to the Itemised non-comparative rating scale, the respondents are provided with the scale that has a number or brief description associated with the category. So, these are 3 different types of item itemised. So, this scales can be of 3 form: one is called itemised graphic scale like for comfort, you just graphically. It can say this is a favourable graphic. This is indifferent, it is neither comfortable or not and it is an unfavourable, it is a discomfort.

So, graphical picture can be used in this itemised scale or it is a verbal and this is most widely used itemised non comparative scale. So, verbal its completely satisfied like if in terms of comfort you can say, it is very comfortable, moderately comfortable; it is neither comfortable .

Similarly, in itemised numerical scale; so, you can use numerical value minus 3, minus 2. So, you can use anyone one of this. So, this is an itemised non-comparative rating

scale. So, these are of different type.

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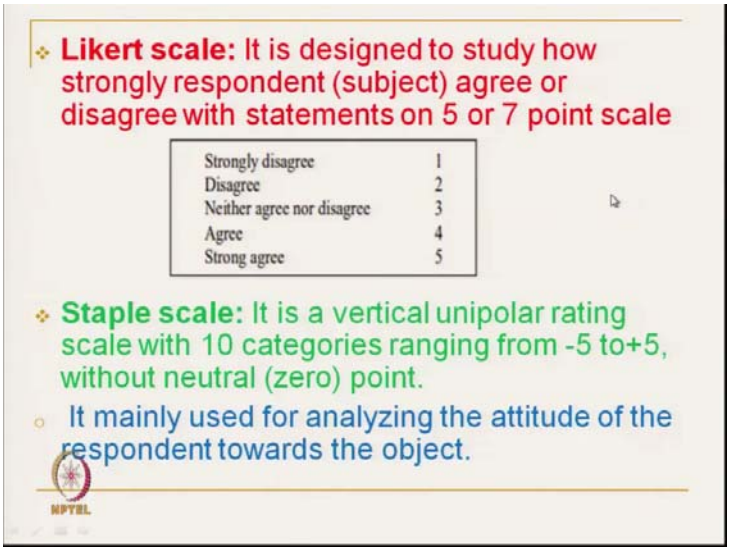

So, 3 different types; Likert scaling, it is designed to study how strongly respondent agree or disagree with the statements and we can use 5 to 7 scale. This is Likert. It depends on the agreement or disagreement. So, if I tell strongly disagree, it is 1. So, this if we want to have this type of study, then we have to use Likert scaling.

Staple scaling is vertically uni-polar rating scale with 10 categories rating from minus 5 to plus 5, but 0 is not taken.

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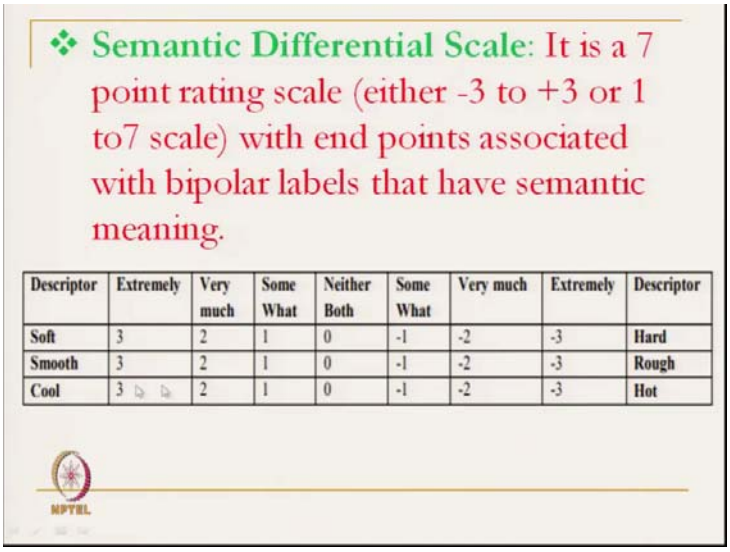

It is a 10 point rating scale without neutral point; so, minus 5 to plus 5. And third one is the semantic differential scale. It is 7 point rating scale minus 3 to plus 3 with 0 point. So, 0 point or 1 to 7; we can use with end points associated with the bipolar label. End point is bipolar, one side will be swapped, another side it will be hard, smooth or rough, cold or hot. These are the bipolar rating and in between we can tell. So, that means, there is no confusion. Earlier you have to define 3 means whether most comfortable or least comfortable. Here, it is given that 3 means extremely soft and minus 3 means extremely hard. So, bipolar labels are already given here.

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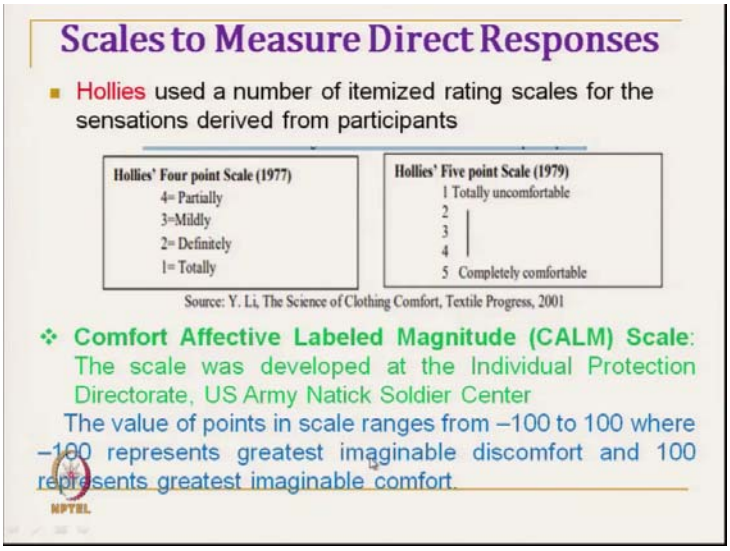

Now, based on all these scaling method, there are different studies carried out. So, we will mention here, few examples, Hollies used number of itemised rating scale for sensation, for different type of perception; it is a 4 point scale he has used. Like one is 4 is partially, mildly 2 is definitely and 1 is totally. So, similarly these are comfort label.

Similarly, in 5 point scale, he has used 1 is totally uncomfortable and 5 is completely comfortable. So, in this way, Hollies used this type of ratings scale. Another is that comfort affective labelled magnitude CALM scale which is used in US Army Natick Soldier Center. So, what they have used? They have used rating point at the range of minus 100 to 100 where minus 100 represent greatest discomfort imaginable, minus 100 and plus 100 is greatest comfort label. So, this is CALM scale.

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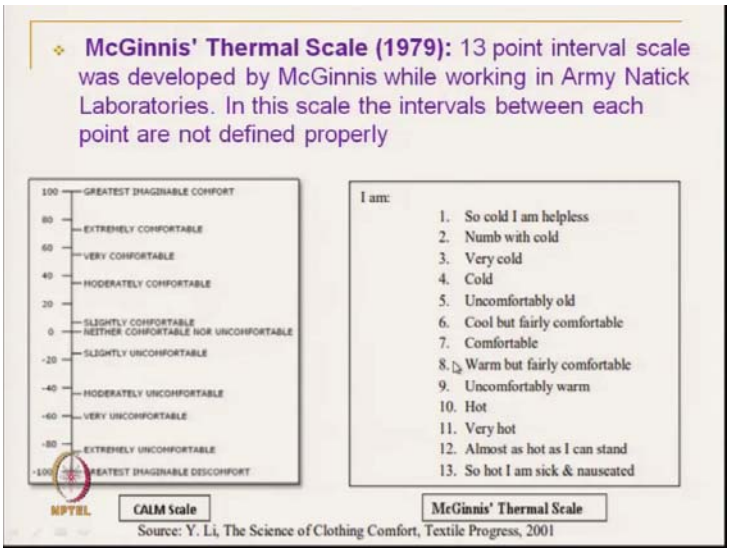

Another scale used is McGinnis thermal scale where 13 intervals scale at the same laboratory they have used. So, 1 in McGinnis thermal scale means I am helpless and 13 means I am so hot, I am sick so; that means, all these labels are are expressed in terms of some sentence or some value.

So, while rating a person will give say, 5 and 6 whatever scale, it will be ok. Similarly CALM scale, plus 100 means greatest comfort and minus 100 means greatest discomfort. So, accordingly one can actually rate it. So, these different scales are also used.

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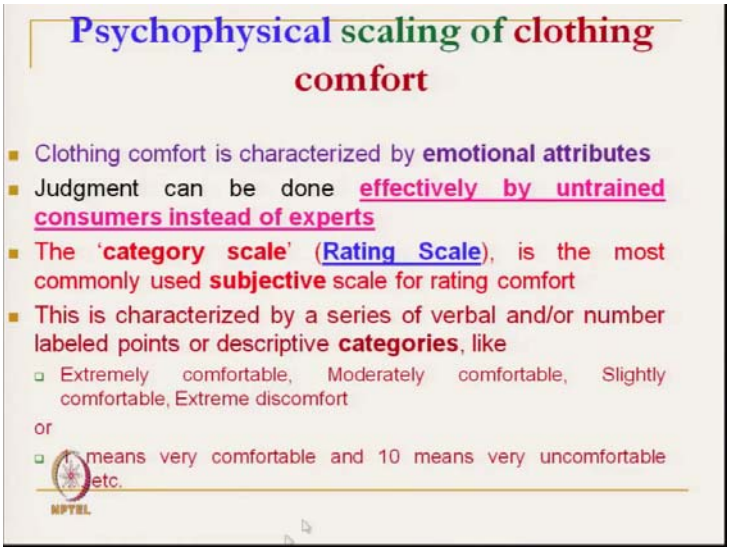

And in thermal comfort, psychophysical scaling of clothing comfort; another comfort scale is used which is called category scale which is the most commonly used subjective scale.

The category scale is exactly like rating scale. We can just rate that extremely comfortable moderately comfortable, slightly comfortable or extremely discomfort. So, this type of ratings are given in terms of number.

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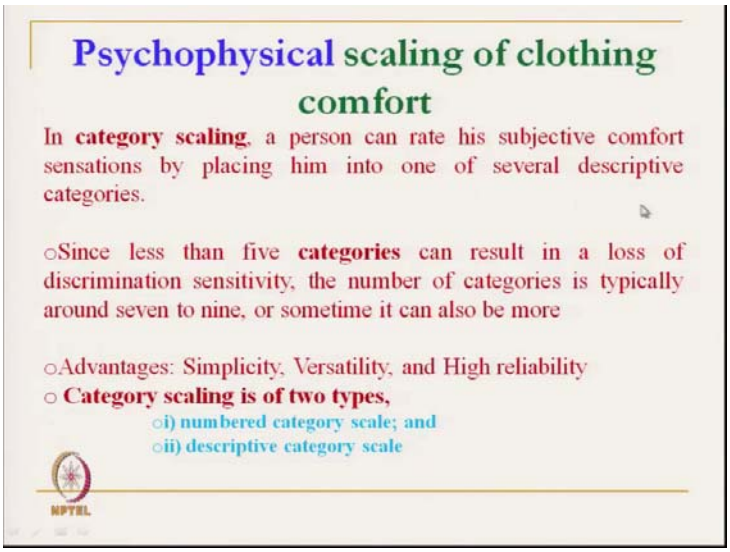

So, in category rating scale, a person can rate his subject comfort sensation by placing him into a several descriptive category. If less than 5 categories used, we use 5 category or 3 category we cannot discriminate. So, distinguish between two sensations. So, better is to use more numbers of category, at least seven categories are actually suggested.

So, the main advantage of the category scale is simple, versatile and higher reliability. So, category rating scale, we can use. These are actually of 2 types: one is the number category scale like we have used earlier in rating scale and descriptive category scale; number 1, 2, 3 or descriptive category scale.

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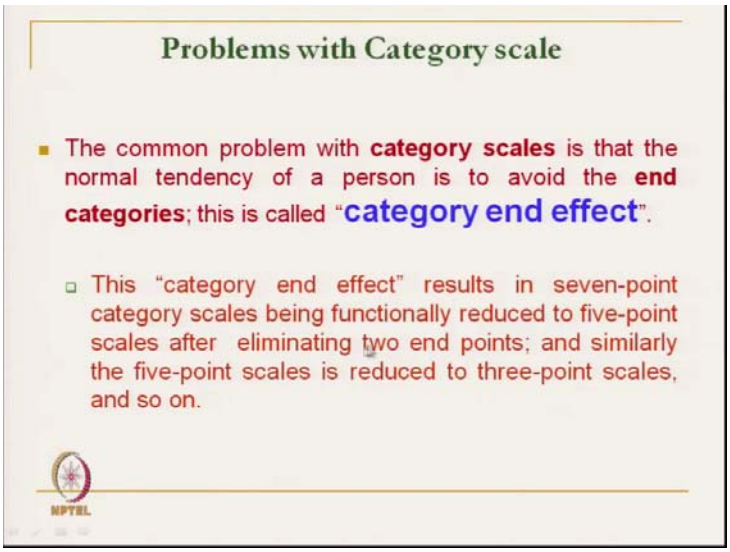

The main problem of category scale or particularly number category is called category end effect. So, if I am in a situation where I have to rate in say one extremely comfortable, then comfortable, moderately comfortable, slightly comfortable or extremely discomfort 1, 2, 3, 4 or another 5 or 7 scale.

The main problem is that in category end effect is the person will normally do not like to rate in extreme point. You try to avoid rating as extremely comfortable or extremely discomfortable; that means, the category end effect results; the seven-point category scale being functionally reduced to five-points. So, two points are reduced and five-point scale reduced to three-point scale.

So, the common problem with the category scale is the normal tendency of a person to avoid the end categories. So, there is biases. So, to avoid main problem with the category scale, we should use large number of categories then end effect will be minimised

Now, we will discuss the best, now we know the scaling pattern, what different types of scales are there, how to scale all these things, we have discussed. Now we will discuss another way of measuring the psychological or psychophysiological clothing comfort sensation; the wear trial which is actually most widely used in measurement of clothing comfort.

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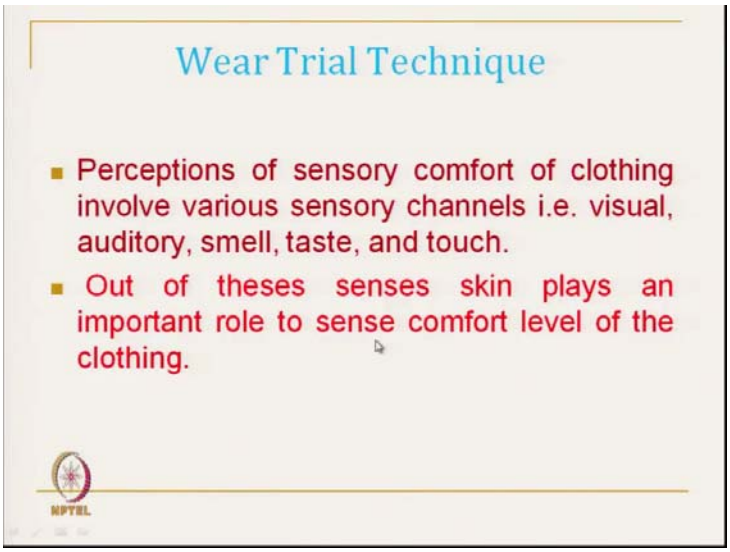

Why do we use Wear Trial? Basically, if we measure the fabric characteristics, cloth characteristics based on the objective measurement or subjective measurement, we will not get the overall sensation. And the perception of sensory clothing comfort involves various sensory channels; visual, auditory, smell, taste and touch. So, all these things, we can only get, if we wear the cloth. So, wear trial technique says that you have to wear a complete cloth and then we get the sensation; that means, out of all sensation; skin plays an important role to sense the clothing comfort level

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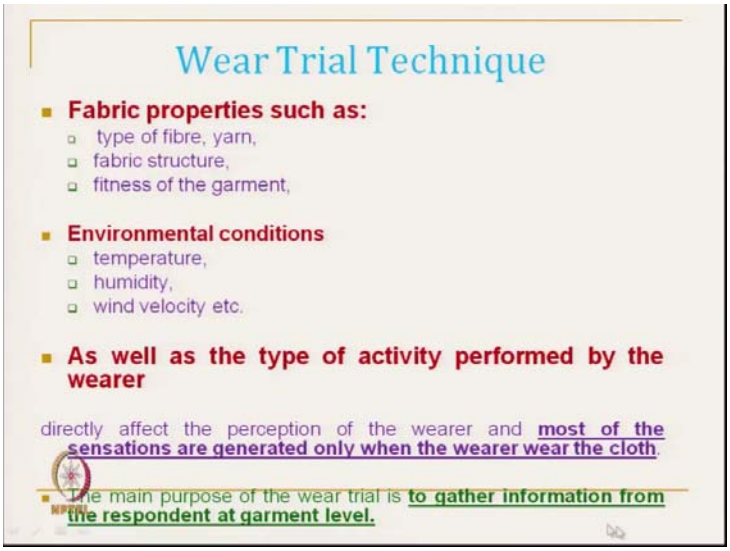

Now, the fabric properties mainly the type of fibre or yarn, fabric structure, fitness of the garment. These are very important actually which controls effect the wear trial response. Next is the environment; temperature, relative humidity and the wind velocity. So, during wear trial, we have to set particular environment humidity. So; if a particular garment we develop from fibre, yarn or fabric, but if we change the temperature; total sensation will be different. If we change the humidity of the climate, it will give us totally different sensation.

So, we have to specify the environmental condition, then only we can get correct response as well as activity level. So, these three parameters are very important, because at different level of activities our sensations are different, we get different types of sensation. So, that is why this activity level is extremely important. So, for any wear trial technique, we have to define our clothing or garment, we have to define our environmental condition and we have to define our activity level; then only we can get the proper response of a particular person. This is the basic design of the wear trial technique

And the main purpose of wear trial is to gather information from the respondent at a garment level. We cannot get the wear trial at the fabric level. At garment level, we get the perfect information.

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So, therefore, the wear trial is an important technique for comfort clothing research. Various sensory attributes, descriptors are generated from the response of the respondent and we get information and this is only possible during wear trial.

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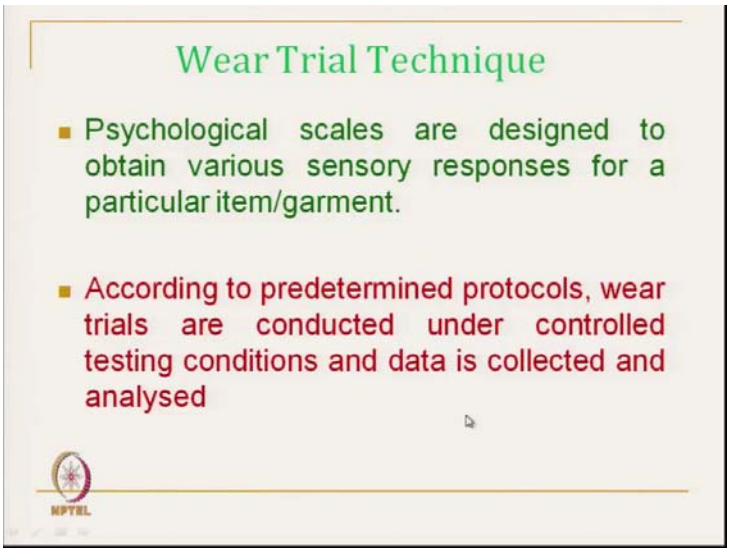

And psychological scales are designed. So, after all these things like our garment selection, environmental selection and activity selection; then we have to design the psychological scaling system. Then, according to the predetermined protocol, you have to define the protocol, then you have to conduct the wear trial technique and collect the data.

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So, why do we need wear trial? Why cannot we have only the objective testing data and get the value? As we have mentioned, wear trial is very important because we get the particular overall sensation only after the wearing the cloth, only after the actual activity, only at actual environmental condition.

Suppose, I am trying to develop a cloth for extreme cold and if I measure only the thermal transmission, thermal transmission or moisture vapour transmission or air transmission. It may not give the exact comfort level of a person say at minus sub-zero, minus 30 degree Celsius, minus 40 degree Celsius temperature. It will not be able to give, we will not be able to simulate that situation. So, for that we have to develop cloth we have to generate that environmental condition, then only through wear trial we can get the actual sensation.

Suppose, the fabric is thermally perfect, but touch wise it does not give proper sensation then we may feel discomfortable. So, to generate reactions of wearer to any perceived discomfort sensation produced by different climatic condition; so, we try to get all these discomfort level at different level of activity and different climatic condition, we try to get this value. This is only possible through the wear trial technique.

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So, different types of external stimuli, heat, moisture, wind all these combined effect we get. These stimulations are normally generated under specific conditions like softness, mechanical stimulation, what is softness, scratchiness, prickliness. If you wear wool in cold condition, we may not get the pricky sensation. Pricky sensation, we will get only at the warm and sweating condition. We can get mechanical stimulation or thermal stimulation in wear conditions and sweating rate depending on level of physical activities.

So, if I start walking, I will have different types of physiological perception. Psychological perception of different physical activities, fitness of clothing like clothing if it is tight fit or loose fit, my total perception or total sensation will be different if it is tight fit. Why wear trial is very much necessary like environmental condition, even if the temperature changes or humidity of the environment changes, little bit total sensation changes, keeping all other activities constant only by changing the humidity or air velocity, total perception will be different. So, we have to design very carefully depending on the actual application of the clothing.

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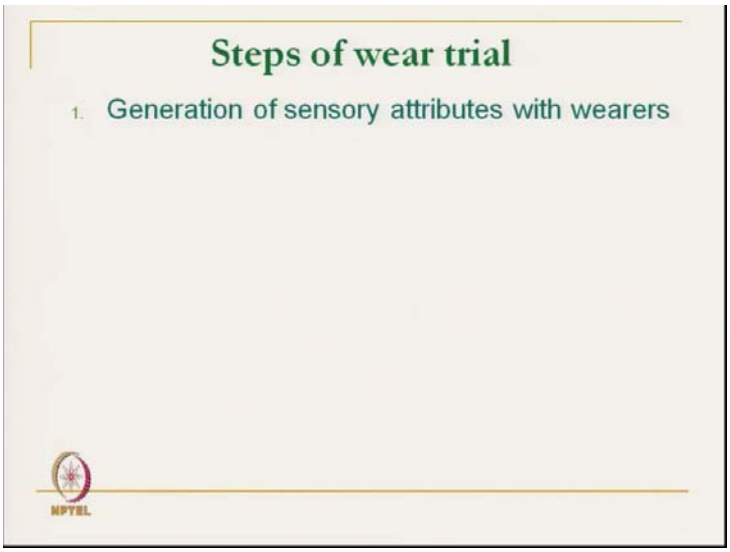

Now, what are the steps that we have discussed? We have to generate the sensory attributes of the wearer. So, all these steps of wear trial, we will discuss in the next class.

Thank you.