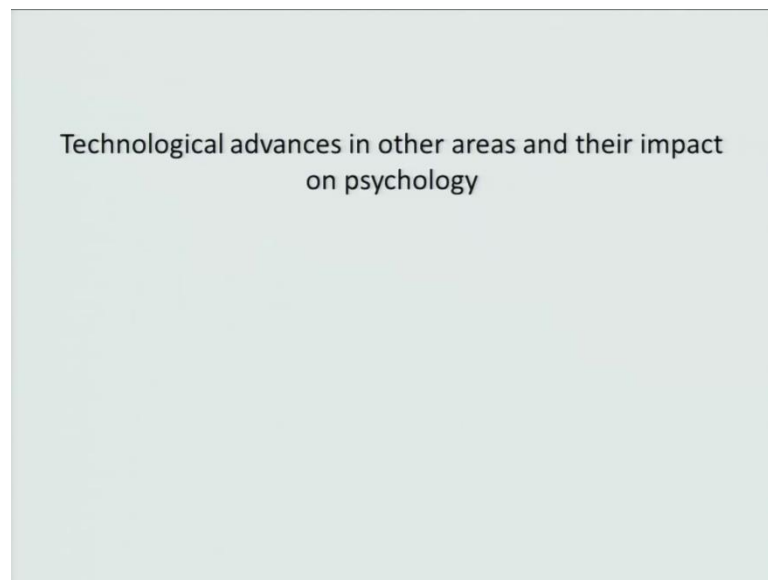


**Selected Topics in Psychology**  
**Positioning Psychology in the Modern Context**  
**Prof. Braj Bhushan**  
**Department of Humanities and Social Sciences**  
**Indian Institute of Technology, Kanpur**

**Technological Advances in other Areas and their Impact on Psychology**

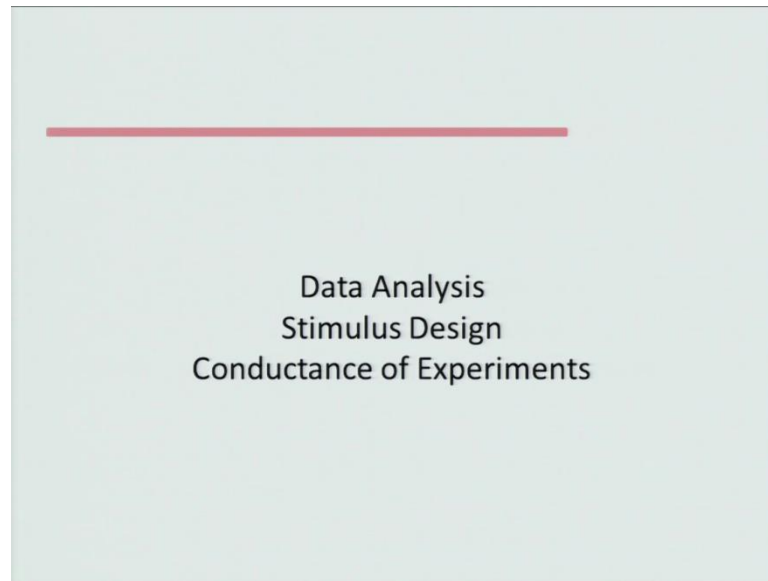
Having gone through all the lectures by these eminent speakers, you must have realized that psychology has traveled long distance of course, cutting its umbilical cord from philosophical influences. And has developed more and more know scientific temper this very last lecture in essence that the remaining two or it will be following, it would be panel discussions.

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This very last lecture is exclusively dedicated to technological advances which were primarily took to the need in other domains of knowledge. But, how psychology has been influenced by it and how those technology are being used in psychology.

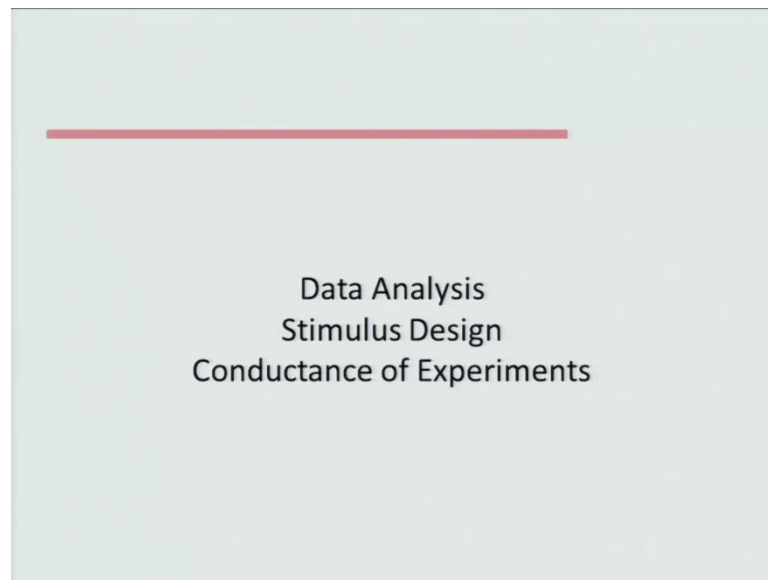
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I must tell you that all of you are aware that, data analysis is something which is extremely dependent on the technological advances. There are several software's both for qualitative as well as quantitative analysis. And Data analysis is something that you cannot get rid of in psychology. And therefore, you can understand how dominant the advances in technological domains have influence psychology.

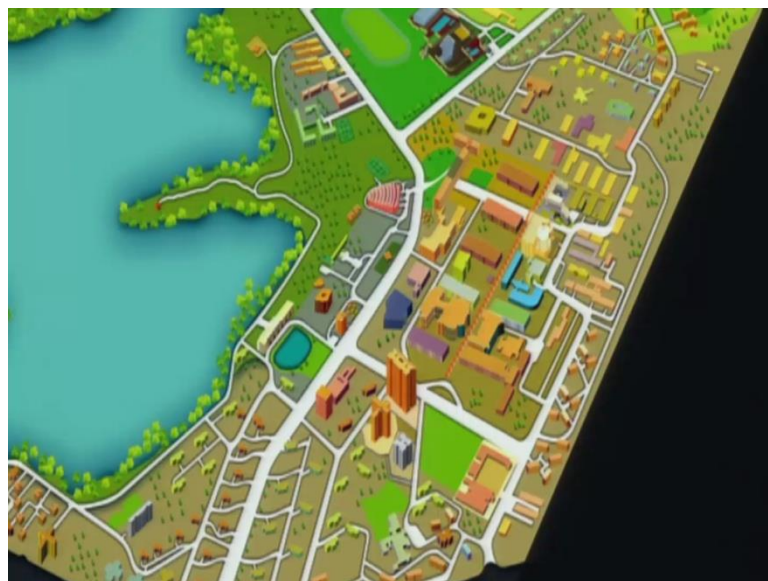
But, two interesting things one that is know the stimulus design has been influenced by the advance that has taken place in technological domain. And two the nature of conductance of experiment has also transformed because, there has been too much of advancements of technology. I am very surgically making selection here and therefore, I am not at all going to talk about data analysis I am not going to talk about conductance of experiments.

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Primarily for two reasons know one that most of you are aware of it and there is futile danger that if I go into looking at the technology that has been very helpful in terms of stimulus design in conductance of experiment. Primarily I would be indirectly talking about few selected know software's that I do not want to do here. Therefore, I just wanted to share with you just t 3 visuals.

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This is map of our campus primarily and this has been designed by non-psychologist colleague of mine, he is basically a designer who is looking into the making of

isomorphic maps. I found it very interesting because know right now 1 of my student is also working on special cognition. And therefore, if you look at the map, whether it is a 2 d map, whether it is a 3 d map, whether it is an isomorphic map.

The angle from which you look at the map or if you are having aerial survey them angle at which you are looking at the space starts influencing you. So, that is an interesting thing and I think that if you have to work on such topics in the laboratory, then it becomes extremely important to look at proper software's are to modify the existing software's so as to get it to your name.

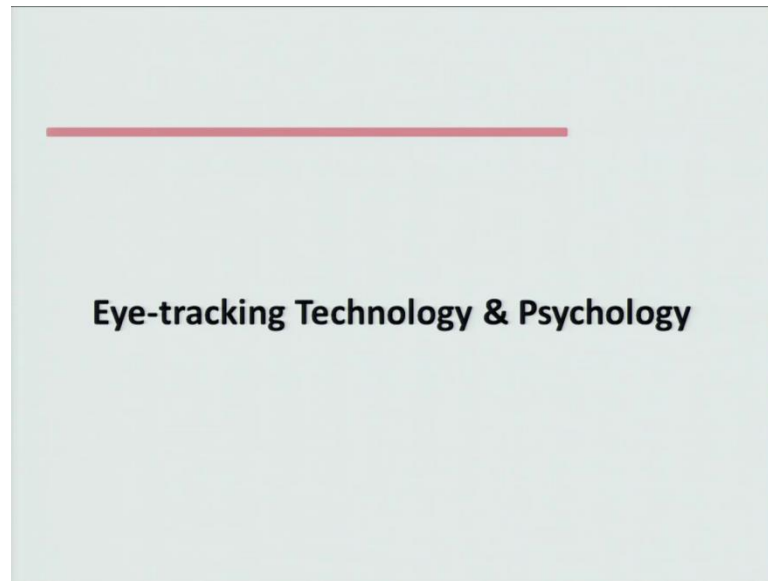
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To the student of mine you know you can see on the screen right now work that this is using a particular software where, you have the possibility of dividing the space into grids. And then in each of these grids you add certain things you can see here most of the grids are unoccupied and few of the grids have certain images and then you can construct whatever you wish. It could be a city, it could be geographical trade, it could be a forest it could be anything and most importantly you would find here is that you can have a walk through.

So something that is otherwise impossible to think of can very easily be known done in the laboratory set up. Simply because you have under gone or you have seen that demonstrated capability of our technology.

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But, in this very last lecture, my focus is exclusively on eye tracking technology and virtual reality. Why did I do this as I told, that I do not want to indirectly endorse any of the software's which supplements know one or the other type of activities that psychologists look forward to. But, then these are two cutting edge technology and I can share with you to the latest information that is available to me that eye tracking technology is available only at 8 centers in India as if now 2013 may.

I am talking about and of course, virtual reality which has not yet come to India but, then in the western world you will see no certain type of research in psychology where virtual reality is being used in the laboratory set up. What I thought was let I will introduce you to the eye tracking technology something that we have a of with us IIT Kanpur. And then I will know just make a survey of publications in the last 5 years that is 2009 to 2013 where eye tracking technology has been used.

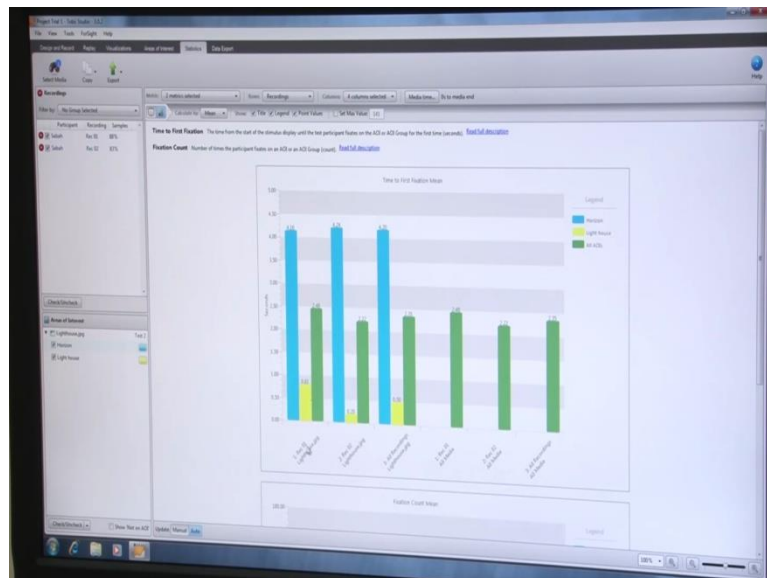
I have extensively done this job so as to do justice to this fact that how advancements in technology which works actually took at to some other name, has been you know very well used. It has been well adapted in psychology.

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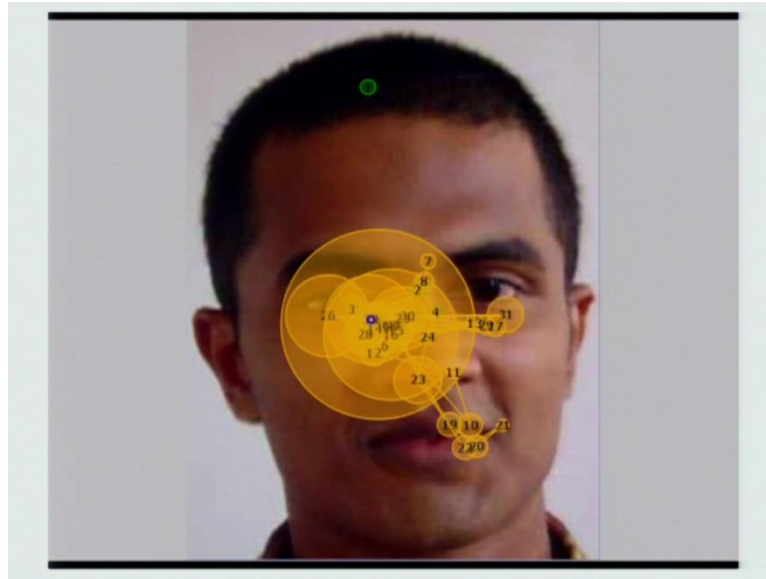
Let me take you to the psychology lab of IIT Kanpur you see the eye tracking machine here and right now what you see is the calibration being done so that, the focus of the participant can be recorded by the machine. And of course, you can see here how the individual's behavior is recorded by the eye tracking machine.

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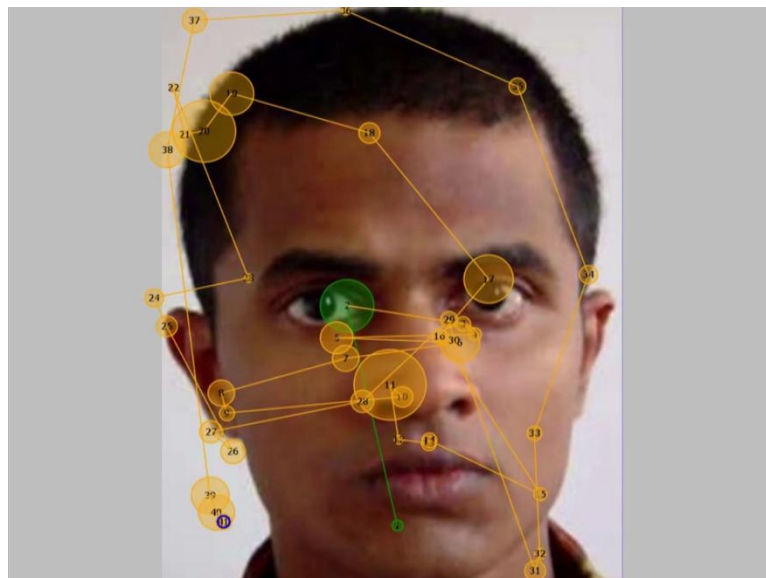
As you know psychologist would always look for the numbers therefore, there are methods of quantifying this gaze behavior and what you see on your screen now, is the quantification of this gaze behavior which has been recorded using the eye tracker.

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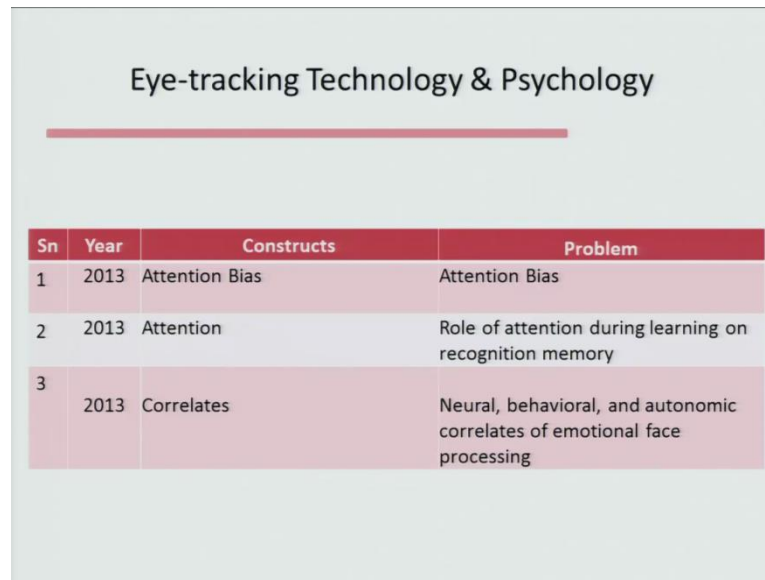
Look at this image on your screen now; this was know an experiment that I had performed couple of years back. And I was interested showing you that you can very easily plot the gaze movement when 1 tries to identify official expression. It has multiple usages of course, right from expression to different types of psychological disorders. 2 issues like deceit for forensic applications, there are there are lot many things that has to do with it.

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But just look at this scan path of a happy expression. You now see scan path for sad expression and now you see the scan path for fear as an expression on the face of the expresser.

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Sn	Year	Constructs	Problem
1	2013	Attention Bias	Attention Bias
2	2013	Attention	Role of attention during learning on recognition memory
3	2013	Correlates	Neural, behavioral, and autonomic correlates of emotional face processing

With this brief introduction to how eye tracker works, I basically come to the eye tracking technology and psychology. For this purpose I have no reviewed the publications that has come to journals in the last 5 years, when I say last 5 years this means 2009 to April 2013.

In 2013 till now when I am recording is start 3 paper have been published: 1 that has to do with attention bias; second, that has to do with attention and third 1 which primarily deals with the neural, behavioral and the autonomic correlates of facial processing. What I will do now is that 1 by 1 I will just briefly summarize know what was done by the researcher in this work that has been published. And on the bottom you can see the full reference, if you are interested going into the details of it you can of course, look at those papers.

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## Eye-tracking Technology & Psychology

- Attention bias toward threats
- Differences in motor reaction time to threat and neutral cues
- Anxious participants displayed greater attention bias toward angry faces
- First and faster fixation to angry faces
- Biased orienting to threat-related stimuli

Consistent with findings from earlier reaction-time studies

Shechner et al. (2013). Attention bias of anxious youth during extended exposure of emotional face pairs: An eye-tracking study. *Depression & Anxiety*, 30, 14-21.

The first paper that was published in 2013 is by Shechner and his colleagues, which talks about attention bias towards threats and primarily what he looks at is, the difference in the motor reaction time to threat and neutral cues. What he found was that anxious participants that display greater attention bias towards angry faces. You remember the research in emotion thus say that anger is processed on priority evolutionary psychologists also talk about it.

Now that emotion processing when you look at their preferences and of course, the sensory getting concept if you attach it to it, then you realize that anger is an emotion is always processed know in priority compute rest of the emotions. Another interesting observation in this study was that the first and faster fixation is always to the angry faces.

This shows bias orientation towards the threat related stimuli what is important to note here is that this is actually consistent with the findings from earlier reaction time studies. So, before know eye tracking technology was being used in psychology there were studies like this but, with the advent of this technology you realize, that with precision you can actually know convey the findings of your study 1. 2, when you say that this was processed on priority you can calculate time in milliseconds. And 3, you can actually know plot the trajectory of scan; what is referred to as scan path.

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## Eye-tracking Technology & Psychology

- 6 and 9 month old infants watched a video of an adult demonstrating a sequence of actions with an object
- Age-related changes in the focus of infant attention during a learning event and subsequent recognition memory for event features
- Role of attention during learning on recognition memory
- At both ages, attention was focused primarily on the object and person

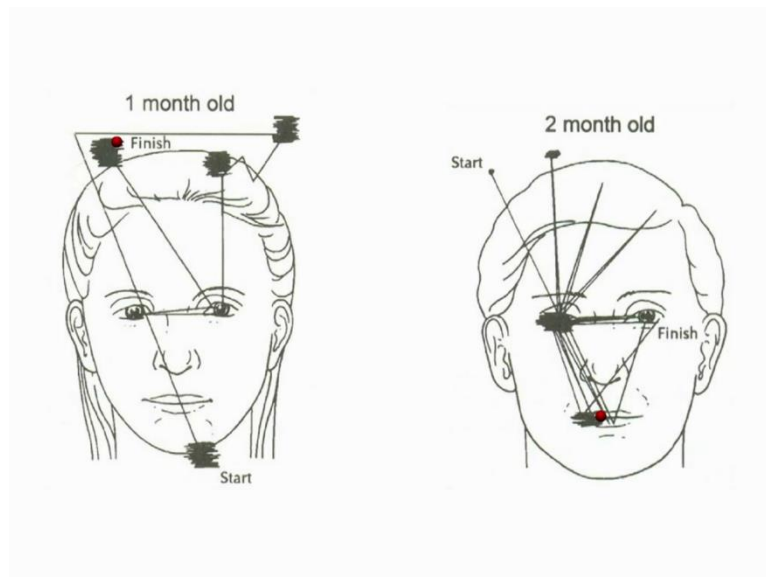
ANOVA, T-test

Taylor, G. & Herbert, J. S. (2013). Eye tracking infants: Investigating the role of attention during learning on recognition memory. *Scandinavian Journal of Psychology*, 54, 1, 14-19.

The second study, which was published this year, was by Taylor and Herbert. What they did was that they took 6 and 9 month old infants and they asked them to watch the video, of an adult demonstrating the sequence of actions with an object. And primarily, they were trying to examine was the role of attention during learning on recognition memory.

What they found was that the age related changes in the focus of infant attention during a learning event and of course, subsequent recognition memory for future events. And at both ages that is 6 and 9 months attention was focused primarily on the object and person. I must tell you that earlier studies know where also conducted on, how facial expression of the care giver especially, father and the mother and then of course, the other care givers. How new born babies or 6 month old baby they scan the facial expression of their parents. And there are interesting studies on this.

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I have just know tried to show you this is not the exactly what was done by these researchers but, look at this animation which shows the eye movement of an infant. Now, what you interesting find here is that, eye tracking as a technology has been used.

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### Eye-tracking Technology & Psychology

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- 6 and 9 month old infants watched a video of an adult demonstrating a sequence of actions with an object
- Age-related changes in the focus of infant attention during a learning event and subsequent recognition memory for event features
- Role of attention during learning on recognition memory
- At both ages, attention was focused primarily on the object and person

ANOVA, T-test

Taylor, G. & Herbert, J. S. (2013). Eye tracking infants: Investigating the role of attention during learning on recognition memory. *Scandinavian Journal of Psychology*, 54, 1, 14-19.

ANOVA and T-test has statistical techniques have been used. So, conventionally and of course, the problem lies no what has been usually the focus of attention by psychologist. So, problem statistical technique everything remains the same but, the new technology is being used.

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## Eye-tracking Technology & Psychology

- ASD have difficulty with social-emotional cues
  - Neural, behavioural, and autonomic correlates of emotional face processing
  - adolescents with ASD and typical development (TD)
  - Eye-tracking and event-related potentials (ERPs)
- ASD showed-
    - atypical pattern of emotional face processing
    - reduced neural differentiation between emotions
    - reduced relationship between gaze behaviour and neural processing of faces

Intelligence tests, EEG, ANOVA

Wagner, et al. (2013). Eye-Tracking, autonomic, and electrophysiological correlates of emotional face processing in adolescents with Autism Spectrum Disorder. *Journal of Autism & Developmental Disorders*, 43, 188-199.

The third study published this year was by Wagner and his associates. They have studied now autism spectrum disorder and they have tried to find out that these ASDs they have difficulty with social emotional cues ok. And then they have found that the ASDs, they show atypical pattern of emotional facial processing 1; 2, they have reduced neural adjective differentiation between emotions and third that reduction in the relationship between gaze behavior and neural processing of the face.

What is very interesting to note here in this study was, that you have intelligence test something which is very well known to all psychologists. Intelligence test has been used you also see that EEG has been used besides eye tracking technology and statistical technique analysis of variance has been used. So, that is an know interesting know mix of the existing tools and techniques and the modern technology.

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## Eye-tracking Technology & Psychology

Sn	Year	Constructs	Problem
4	2012	Anxiety disorders	Trait and state anxiety on attentional biases
5	2012	Learning Visual perception	Learning to segment a novel, occluded object in a scene
6	2012	Attentional biases	Existence of specific information-processing biases, such as attentional biases, that are related to persecutory beliefs
7	2012	Belief	Source evaluation
8	2012	Long-term working memory	Influence of interruption, background speech and music on reading
9	2012	Social Phobia	Relationship between the time-course of attention and symptoms of social anxiety and depression

Last year, that is 2012, I found 6 papers were published in scientific journals where eye tracking technology has been used. The constructs that have been studied are anxiety disorders, learning visual perception, attention bias, belief, long term working memory and social phobia. And the problems are also very interesting first paper talks about trait and state anxiety on attentional bias. Second paper talks of learning to segment novel occluded objects in scene.

The third paper talks about existence of a specific information processing bias such as, attentional bias. The fourth paper talks about source evaluation the next paper talks about influence of interruption background speech and music on reading. And the last paper talks about the relationship between time course of attention and symptoms of social anxiety and depression. So, whole wide range of know topics have been taken into account.

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## Eye-tracking Technology & Psychology

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- Attention bias for threatening stimuli
- Relative influences of trait and state anxiety on attention bias emotional images
- State anxiety was correlated with increased attention to threatening images regardless of trait anxiety
- Durations of initial gaze and average fixation were longer on threat versus neutral images

Personality, Anxiety disorders & Attention to threat

Quigley et al. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition & Emotion*, 26, 1390-1411.

Now in 2012, the first paper added I am referring to here is by Quigley and his associates which talks about attention bias for threatening stimuli. And here the relative influence is of threat and state anxiety on attentional bias pertaining to emotional images has been studied. What Quigley and his associates found was that state anxiety was correlated with increased attention to threatening images regardless of the trait anxiety of the participant.

And importantly the duration of the initial gaze and the average fixation were always longer on threat stimuli compared to the neutral images. What you interestingly find here is that personality has been used as a construct you find anxiety disorder which has been for gain of prime importance and significance to psychologists and attention to threat. All 3 constructs are older constructs.

They have been thoroughly examined in psychological literature but, then you find a these constructs are revisited using eye tracking technology.

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## Eye-tracking Technology & Psychology

- fMRI & eye-tracking were used to examine the mechanisms involved in learning to segment a novel, occluded object in a scene
- Role for effective visual sampling and prior experience in the development of mature object perception
- Neuroimaging data suggest an involvement of the hippocampus and BG, as well as visual cortical and fronto-parietal regions

Learning, Visual perception, fMRI & Eye tracking

Emberson, L. L. & Amso, D. (2012). Learning to Sample: Eye Tracking and fMRI Indices of Changes in Object Perception. *Journal of Cognitive Neuroscience*, 24, 2030-2042.

The second paper that has been published in 2012, that was by Emberson and Amso. And what they did was that they combined both: the functional magnetic results immersing and eye tracing technique. And they used it to examine the mechanism that is involved in learning to segment novel occluded object in a scene. They were trying to understand the role of effective visual sampling and prior experience in the development of mature object perception. Now, object perception pattern recognition these are known well researched areas in psychology. But, then you find 2 of the cutting its technology being used by researcher what did they find.

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## Eye-tracking Technology & Psychology

- fMRI & eye-tracking were used to examine the mechanisms involved in learning to segment a novel, occluded object in a scene
- Role for effective visual sampling and prior experience in the development of mature object perception
- Neuroimaging data suggest an involvement of the hippocampus and BG, as well as visual cortical and fronto-parietal regions

Learning, Visual perception, fMRI & Eye tracking

Emberson, L. L. & Amso, D. (2012). Learning to Sample: Eye Tracking and fMRI Indices of Changes in Object Perception. *Journal of Cognitive Neuroscience*, 24, 2030-2042.



Now there neuroimaging data suggested and involvement of the hippocampus and Basal ganglia, as well as the visual cortex and fronto-parietal regions of the brain. So, the psychological constructs you find learning visual perception, technology you find functional magnetic resonance imaging and eye tracking being used in this research. So, perfect combination, by this time the modern technology, the existing constructs psychology and the relevant problems.

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**Eye-tracking Technology & Psychology**

- Specific information-processing biases, such as attentional biases, that are related to persecutory beliefs
- Activation of depressive cognitive schemas facilitate attention bias in those with subclinical paranoia
- This favours the depression-based model of paranoia
- Specific cognitive processes in psychopathology
- Helps test competing etiological models

**Cognitive model of paranoia**

Provencio et al. (2012). Depressive Primes Stimulate Initial Avoidance of Angry Faces: An Eye-Tracking Study of Paranoid Ideation. *Cognitive Therapy & Research*, 36, 483-492.

Third paper that was published in 2012, was by Provencio and his associates who worked on a specific information processing bias such as attentional bias, that has to do with the persecutory belief. Now, people studying pathological behavior, people studying paranoia, they have been know using this constructs since I do not know how long where, the whole idea of persecutory belief has been studied.

In this case, the activation of depressive cognitive schema was examined because, it is considered that they facilitate attention bias in those belong to the subclinical paranoia domain. Now this favors the depression based model of paranoia. Clinically studies on paranoia, clinical studies on depression and especially the subclinical paranoia you combine the cognitive process in psychopathology.

But, then using eye tracking technology what you succeed doing is that you are trying to examine or revisit the ethological model of paranoia or the persecutory belief. So, it is a fantastic combination of the recent technology that is being used to know revisit the



oldest 1 of the oldest existing constructs in psychology in psychopathology. And then also redefining psychopathology, in terms of cognitive processes and also verifying the ethological model of paranoia.

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The slide is titled "Eye-tracking Technology & Psychology" and features a red horizontal line below the title. It contains two columns of bullet points. The left column discusses how search engine interfaces and internet-specific epistemic beliefs influence novices' source evaluations during web searches, specifically mentioning a medical topic. The right column discusses how strong beliefs about the web containing correct knowledge affect information selection and search outcomes. A red rounded rectangle at the bottom contains the text "Trust, User interface". At the very bottom, a small citation is provided.

- How interface of search engines and Internet-specific epistemic beliefs influence novices' source evaluations during Web search
- Medical topic
- Those with strong belief that the Web contains correct knowledge showed—
  - more focused information selection
  - better search outcomes

Trust, User interface

Kammerer, Y. & vonne, G. P. (2012). Effects of search interface and Internet-specific epistemic beliefs on source evaluations during Web search for medical information: an eye-tracking study. *Behaviour & Information Technology*, 31, 83-97.

The other paper that was published last year that is in 2012 was by Kemmerer and Vonne. And they were primarily interested finding out that how interface of search engines. And the internet specific epistemic belief they influence the novices source evaluation in the web search process. What he did was basically he took medical topics and when we search using 1 or the other search engines.

Now it is it is very common practice how do you trust, the what you called the appropriateness of or how do you consider that, the information that is given on a particular website is really valid information. So, they were trying to do this so it was basically the trust factor, it had to do with the web content, it had to do with the medical search process. But, very interestingly it also has to do with user interface and those who are in design, those who are into psychology design, those who are into user experience design and those who are into human computer interaction. They really know admire this very process of learning the users experience know or what is called as user interface.

Now, what they found was that those who had strong belief that the web content correctly know showed the knowledge. They were more focused know on the

information selection and they also realized that the it has some betterment effect on the outcomes.

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**Eye-tracking Technology & Psychology**

- Influence of interruption, background speech and music on reading
- Participants read paragraphs while being exposed to
  - background speech or
  - music or
  - read the texts in silence
- Interruptions increased reading time
- Background speech slowed down the reading rate as compared to reading in the presence of music or reading in silence

Congruent with theory of long-term working memory

Cauchard et al. (2012). Influence of Background Speech and Music in Interrupted Reading: An Eye-Tracking Study. *Applied Cognitive Psychology*, 26, 381-390.

Cauchard and his associates know they published another paper in 2012, where they tried to find out the influence of interruption background speech and music on reading. I remember my own days not only my young student days but, even now at many occasions when I work on certain thing, I do play some light music in the background. And that basically, now helps me get read of this monotony effect. It also reduces the mental fatigue this is a subjective experience.

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## Eye-tracking Technology & Psychology

- Influence of interruption, background speech and music on reading
- Participants read paragraphs while being exposed to
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  - music or
  - read the texts in silence
- Interruptions increased reading time
- Background speech slowed down the reading rate as compared to reading in the presence of music or reading in silence

Congruent with theory of long-term working memory

Cauchard et al. (2012). Influence of Background Speech and Music in Interrupted Reading: An Eye-Tracking Study. *Applied Cognitive Psychology*, 26, 381-390.

Now, here the researchers what they did was they were trying to see if the interruptions, the background speech and if you play music in the background what type of impact it has on reading. So the participants were asked to read paragraphs while they were exposed either to background speech or to music or they were supposed to read the text in complete silence. What did they define?

They found that interruptions increase reading time very obvious but, what they also found was that the background speech slow down the reading rate as compared to the reading in the presence of music or reading in silence. Now, this is actually congruent with the theory of long term working memory. Long term memory, long term working memory both have been know of interest to psychologist. In the neuropsychological section you did here Professor Vivek when you are talking about heart and the brain.

Of course, the focus was very little on music and the processing of the brain and how other cognitive domains get facilitated when you have music in the background. But, in this study you find using eye tracking technology the researchers claim how background music can know become a facilitator of a psychological phenomena.

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## Eye-tracking Technology & Psychology

- Social phobia: biased attention help maintain symptoms
- Characteristics of biases-
  - hypervigilance to threat cues
  - difficulty disengaging attention from threat
  - Avoidance of threat cues
- Social anxiety associated with attention to emotional (rather than neutral) faces
- Difficulty disengaging from angry expressions
- Relationship between heightened depressive symptoms and increased attention to fear faces

Testing competing models

Schofield et al. (2012). Social anxiety and difficulty disengaging threat: Evidence from eye-tracking. *Cognition & Emotion*, 26, 300-311.

Another paper that was published last year that is 2012 was by schofield and his associates they studied social phobia and they were trying to look at the bias in the attention. Whether they help in maintaining the symptoms of social phobia or not now the characteristics of these biases include hyper vigilance to some threatening cues difficulty disengaging attention from threat and of course, the avoidance of that threat cues. What they found was that social anxiety associated with attention to emotional faces rather than the neutral once.

There was difficulty disengaging from angry expressions you remember 1 of the papers we have right now discussed know where on priority angry expressions were know analyzed. And they also found a relationship between the height and depressive symptom and the increased attention to the fear faces. Now this very work besides know adding to social phobia research, it also know helps us understand the know what you call experimentally testing the computing models that tried to describe the phenomena of social phobia. So that is another interesting way.

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### Eye-tracking Technology & Psychology

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Sn	Year	Constructs	Problem
10	2011	Depression and Dysphoria	Attention and memory biases for emotional information
11	2011	Perceptual-motor processes	Infants' visual exploration
12	2011	Problem solving	Multi-digit addition
13	2011	Decision making	Decision processes in simultaneous lineups

In 2011, 4 papers were published and the primary constructs that work no examined in those papers were depression, perceptual motor processes problem solving and decision making.

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### Eye-tracking Technology & Psychology

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- Attention and memory biases for emotional information in those with depression and dysphoria

- Depressed and dysphorics had poorer memory

Implications for cognitive models of depression and vulnerability to depression

Sears et al. (2011). Attention to Emotional Images in Previously Depressed Individuals: An Eye-Tracking Study. *Cognitive Therapy & Research*, 35, 517-528.

In 2011, first paper that I am referring to is by sears and his associates who tried to examine attention and memory bias for emotional information in people suffering from depression and dysphoria. And they found that people who suffer from these 2 they also have poor memory. Now, besides this very finding this experimental this very paper the findings of this very paper has implication for the cognitive model of depression and they also talked about the vulnerability of depression.

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The slide is titled "Eye-tracking Technology & Psychology" and features a red horizontal line below the title. It contains two columns of bullet points. The left column lists "Infants' visual exploration during natural interactions" and "Gaze behaviour during free play with mothers". The right column lists "Visual exploration" with sub-points: "Opportunistic", "depends on the availability of information", and "limited by constraints of infants' own bodies". A red rounded rectangle at the bottom contains the text "Perceptual-motor process". At the bottom left, there is a citation: "Franchak et al. (2011). Head-Mounted Eye Tracking: A New Method to Describe Infant Looking. *Child Development*, 82, 1738-1750."

### Eye-tracking Technology & Psychology

- Infants' visual exploration during natural interactions
- Gaze behaviour during free play with mothers
- Visual exploration
  - Opportunistic
  - depends on the availability of information
  - limited by constraints of infants' own bodies

Perceptual-motor process

Franchak et al. (2011). Head-Mounted Eye Tracking: A New Method to Describe Infant Looking. *Child Development*, 82, 1738-1750.

Franchak and his colleagues they have now published another paper in 2011, where they talked about infant's visual exploration during natural interaction. So, basically when children they freely play with their mother how do they look at, where do they look at? So, gaze behavior during free play with the mothers very interestingly the findings work that these children, these infants they actually explore.

So, their visual exploration has 3 interesting thing: 1 opportunistic exploration; 2 that they depend on the availability of information and 3 that they are limited by constraints of their own bodies. So in terms of looking at infant's perceptual motor behavior and of course, the visual gaze pattern this is an interesting study that way.

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## Eye-tracking Technology & Psychology

- Multi-digit addition
- Cognitive instantiation of this carry effect
- Eye fixation behaviour during addition problem verification
- Need for a carry is recognized very early during the encoding of the problem

Problem solving, Reaction time, ANOVA, Logistic regression

Moeller, Klein & Nuerk (2011). Three processes underlying the carry effect in addition - Evidence from eye tracking. *British Journal of Psychology*, 102, 623-645.

Another interesting study by Moeller Klein and Nuerk was on the multi digit addition task. Which talks about basically problem solving and of course, they have taken reaction time is measured. But, here they talk about the multi digit addition and they are looking at the cognitive instantiation of the carry effect. So, when you have to add and you have a carryover no when which you take to the next 1.

So how eye fixation behavior works during the verification of an additional problem? And they found that there is a need for a carry that is actually recognized very early during the encoding of the problem itself. So, in terms of understanding how 1 solves numerical problem, in terms of understanding how 1 performs complex addition where 1 has to carry.

So, numbers say 2 digit or more than 2 digit addition where you have a carryover effect. It was now found at encoding actually is a stage where know this thing the neat for carryover is realized. Besides and now talking about problem solving and of course, reaction time, what you interestingly find is also the application of techniques such as analysis of variants and logistic regression in this study.

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## Eye-tracking Technology & Psychology

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- Decision processes in simultaneous lineups
- Array of faces in which a 'suspect' face is displayed along with foil faces
- Lineup decisions can be predicted by face dwell time and the number of visits made to faces

Decision making, Forensic Psychology

Flowe, H. & Cottrell, G. W. (2011). An examination of simultaneous lineup identification decision processes using eye tracking. *Applied Cognitive Psychology*, 25, 443-451.

Another study published in 2011 was by Flowe and Cottrell. They were working on the decision-making process in simultaneous lineups. So you have an array of faces of a suspect and then basically you have to know find out at the suspect who is along with or over face is represented along with the foil faces. Now, this besides we are now being of importance for decision making this also has to this also has extreme forensic relevance.

Because, you identify a suspect or missed a set of neutral people, people who are not in world in the crimes. Now they found at the lineup decisions can be predicted by face dwell time and the number of visits made on the face. Now, there are situations in real forensic examinations where, either the police officer asks you to do that or you are asked to identify the person in the court of the law.

Where you have a suspect and you have others who resemble to the individual they are supposed to very similar type of close and stuffs like this and then you are supposed to identify the suspect. Now, there are cases know where people revoke their decisions in the court of law although they had said something else before the police officer in the court of law they reverse the decision. Now, studies like this which actually tells you that how times you visit the face of the suspect, can actually know actors as predicted is an interesting finding from that point of view.

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## Eye-tracking Technology & Psychology

Sn	Year	Constructs	Problem
14	2010	Attention	Distribution of attention during judgments of analogical similarity
15	2010	Attention Memory	Biases in the allocation and disengagement of attention in dysphoric individuals
16	2010	Information processing in children	Perception of others' feeding actions
17	2010	Attention	Attention
18	2010	Infants	Importance
19	2010	Perception Attention	Encoding strategy use in primary school children

Now, I come to 2010 and you find 6 papers were eye tracking technology has been used and the constructs primarily studied over attention, memory, information processing in children and perceptual processes.

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## Eye-tracking Technology & Psychology

- Effect of prior experience on the distribution of attention during judgments of analogical similarity.

Clement et al. (2010). An eye-tracking analysis of the effect of prior comparison on analogical mapping. *Current Psychology*, 29, 273-287.

The first study that I am taking from 2010 is by Clement and his associates who studied the effect of prior experience on the distribution of attention during judgment of analogical similarity.

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## Eye-tracking Technology & Psychology

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- Biases in the allocation and disengagement of attention in dysphoric individuals.
- Dysphoric individuals spent significantly less time attending to positive images.
- Poorer memory for emotional images.
- Differences in the attentional and memory biases observed in depressed and dysphorics

Attention, Memory

Sears et al. (2010). Attentional biases in dysphoria: An eye-tracking study of the allocation and disengagement of attention. *Cognition & Emotion*, 24, 1349-1368.

Second paper that was published was by Sears and his colleagues who worked on the biasing allocation and disengagement of attention in dysphoric individuals. What they found was that the dysphoric individuals they spent significantly less time on positive images that was 1. They also found poorer memory for emotional images. And they found difference in the attention and the memory bias that is seen in people who are depressed verses those, who have dysphoria.

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## Eye-tracking Technology & Psychology

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- Perception of others' feeding actions
- 6-month-olds can anticipate that food is being brought to mouth while observing adult's feeding
- But they fail to anticipate self-propelled spoons that move toward the mouth
- 10-month-olds and adults anticipate self-propelled
- Only adults anticipate combing actions
- Movement towards the mouth and manual combing actions directed toward the head

Information processing in children

Kochukhova, O. & Gredebäck, G. (2010). Preverbal infants anticipate that food will be brought to the mouth: An Eye tracking study of manual feeding and flying spoons. *Child Development*, 81, 1729-1738.

Another studied that was published in 2010 worked on the perception of others feeding actions. So, when adults they feed infant how the babies they perceive the feeding action of those adults. So, once again the study has now focused on 6 month old infants. And

what was found was that these infants can anticipate that food is being brought to their mouth, when they look at the adults. But, then they it was found that they fail these infants they fail to anticipate self propelled spoons that move towards the mouth.

So, you need actually you know an adult to move the spoon to the to the mouth of their infants to make them realize that they are actually going to be fed; whereas, in the absence of an adult figure, they do not realize so. They also found that the 10 month old babies and the adults they can very easily know anticipate the self propelled spoons. And of course, adults can anticipate the combining actions also but, this interesting study actually talks about information processing in children.

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The slide is titled "Eye-tracking Technology & Psychology" and features a red horizontal line below the title. It contains two columns of bullet points. The left column discusses attention priorities and time-course analyses. The right column discusses ASDs being rapidly cued by gaze direction and an increase in fixation duration. At the bottom, there is a red box with the text "Autism Spectrum Disorders (ASD)" and a citation for Freeth et al. (2010).

### Eye-tracking Technology & Psychology

- Priorities of attention to the region of the face containing the eyes
- Time-course analyses to understand the difference between normal control and ASD groups
- ASDs were rapidly cued by the gaze direction
- Immediate increase in total fixation duration at the location of gaze

Autism Spectrum Disorders (ASD)

Freeth et al. (2010). Do gaze cues in complex scenes capture and direct the attention of high functioning adolescents with ASD? Evidence from Eye-tracking. *Journal of Autism & Developmental Disorders*, 40, 534-547.

Now, another study that was published in 2010 was once again on ASD the autism spectrum disorder by Freeth and his colleagues were talked about priorities of attention to the region of the face that contains the eyes. You know that aged people they usually avoid maintaining eye contacts.

So, the time course analyses to was performed to understand the difference between normal control and those with autism spectrum disorder. And it was found that the ASD's where rapidly cued by the gaze direction and there was an immediate increase in total fixation duration at the location of the gaze.

## Eye-tracking Technology & Psychology

- Encoding strategy used by primary school children
- Assessment of free recall and recognition for target items
- Measuring resistance to interference
- Developmental changes between the ages of 7–10 years in
  - ability to inhibit distraction and
  - resist interference
- Improvement in capability to strategically focus on task-relevant aspects

Roebers et al (2010). Encoding strategies in primary school children: Insights from an eye-tracking approach and the role of individual differences in attentional control. *Journal of Genetic Psychology*, 171, 1-21.

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In 2010, another study was published by Roebers and his associates of who worked on the encoding strategies used by primary school children and once again they had used the free recall technique.

So this was basically assessment of free recall and recognition for target items and they have measured resistance to interference by these primary school children. The findings of this study talks about the developmental changes between the ages of 7 to 10 years especially, in terms of ability to inhibit distraction and to resist interference. So, primarily we talked about improvement in the capacity to strategically focus on task relevant aspects in the case of primary school children.

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## Eye-tracking Technology & Psychology

- Eye-tracking measure of relational memory
- 9-month-old infants can encode memories in terms of relations among items
- This function is subserved by the hippocampus

Memory, Brain, Infants

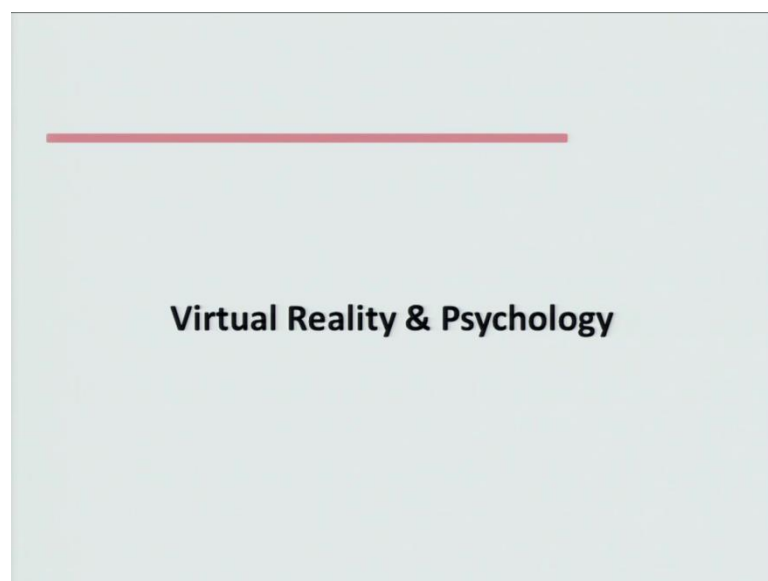
Richmond, J. & Nelson, C. (2009). Relational memory during infancy: evidence from eye tracking. *Developmental Science*, 12, 549-556.

Only 1 studied that I found published in the year 2009 was by Richmond and Nelson, who had worked on memory. So basically, they had used eye tracking measures and tried to look at it from the relational memory point of view they had also worked on infants the 9 month old infant.

They were found to encode memory in terms of their relationship among the items know and this function actually is sub served by the hippocampus. So, something that is remarkable here is that you find at couple of these studies focusing on infants. That group of human population which otherwise is very difficult to be examined. That, it is very difficult to make them know participate in an experiment and to precisely know come forward with the finding. You find that know eye tracking technology as an intervention has really helped psychology in big way.

What you also find is note that clinical population has also been examined and of course, know several perceptual motor and other psychological functions have also be examined.

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Now, it is time for me to focus on how virtual reality as a technology has been used in psychology. Unfortunately, we do not have the virtual reality facility with us and to the best of my knowledge, this country as of now virtual reality facility is not available. But, what I will do that I will try to show you how actually the stimulus looks like. If I uses know the head mount the visual that is used in visual reality research.

Look at this building this is the new core lab of IIT Kanpur and if I walk know from the main entrance towards the car doors reaching the psychology lab. If you use the head mounted virtual reality this is how it would look like.

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Virtual Reality & Psychology			
Sn	Year	Constructs	Problem
1	2013	Sexual deviation	Sexual preferences and intentional dynamics
2	2013	Counterintuitiveness	Verification of minimally counterintuitive ideas (MCI)
3	2013	Social skills	Improving social skills, cognition, and functioning in autism
4	2013	Fibromyalgia	Cognitive behavioral therapy (CBT) in the treatment of fibromyalgia
5	2013	PTSD	Evidence-based treatments (EBT) to address PTSD

Interestingly, in 2013 5 papers have been published where virtual reality has been used as a technique. And here the constructs have been studied such as sexual deviation, such as counter intuitiveness, social skills. fibromyalgia and posttraumatic stress disorder.

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Virtual Reality & Psychology	
<ul style="list-style-type: none"><li>• Child molesters and sexually non-deviants</li><li>• Sexual arousal and gaze behaviour was assessed to characterise sexual preferences and intentional dynamics</li></ul>	<ul style="list-style-type: none"><li>• Analysis of average gaze radial angular deviation</li><li>• Use of virtual reality in probing phenomenology of child molestation</li></ul>

Renaud et al. (2013). Using immersive virtual reality and ecological psychology to probe into child molesters' phenomenology. *Journal of Sexual Aggression*, 19, 102-120.

The first study that I am referring to here that was published this year was by Renaud and his associates who examined the child molesters and sexually non-deviant people. Now, sexual arousal and gaze behavior was assessed to characterize sexual preferences and intentional dynamics. So, you find a gaze behavior which is actually an outcome of the eye tracking and virtual reality which is yet another technology is being used. And then what they found was that the analysis of average gaze radial angular deviation can be used to identify people, who could be you know molesters.

So once again the findings of this study if they are validated by others also could be of great help to the law enforcement agencies. And this also shows the use of virtual reality in probing the phenomenology of child molestation. So, both it has clinical application it has forensic application.

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**Virtual Reality & Psychology**

- Intuitive and counterintuitive test items
- Free recall of displays immediately and after varying delays
- Cross-cultural empirical support for Pascal Boyer's theory
- Concepts with a small number of counterintuitive features are better remembered and more faithfully communicated than extremely counterintuitive concepts

**Counterintuitiveness**

Hornbeck, R.G. & Barrett, J.L. (2013). Refining and testing "counterintuitiveness" in virtual reality: Cross-cultural evidence for recall of counterintuitive representations. *International Journal for the Psychology of Religion*, 23, 15-28.

Another study that was published this year was by Hornbeck and Barrett. And they actually examined the intuitive when counterintuitive test items the free recall of display is now and how immediately and after certain delays how this things work. Basically, they were found a cross cultural support for Pascal Boyer's theory.

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## Virtual Reality & Psychology

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- Feasibility of an engaging Virtual Reality Social Cognition Training intervention focused on enhancing social skills, social cognition, and social functioning
- Virtual reality platform is a promising tool for improving social skills, cognition, and functioning in autism

Social interventions, High-functioning autism

Kandalaft et al. (2013). Virtual reality social cognition training for young adults with high-functioning autism. *Journal of Autism & Developmental Disorders*, 43, 34-44.

The third study that was published this year was by Kandalaft and his associates. Who talked about the feasibility of an engaging virtual reality social cognition training intervention which was primarily focused on enhancement of social skill social cognition and social functioning. And here virtual reality platform has been used as a promising tool that can improve all this 3 interestingly in autistic children. So, that is an interesting thing you find her eye functioning autism, group and you also find social interventions.

Both of these things have been of prime interest to people in clinical domain of psychology. But, here you find virtual reality being used to understand and explain certain phenomena's.

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## Virtual Reality & Psychology

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- Effectiveness of virtual reality (VR) as an adjunct to cognitive behavioral therapy (CBT) in the treatment of fibromyalgia (FM)
  - Sessions of group CBT with adaptive virtual environment containing a specific content for developing relaxation and mindfulness skills
- Patients assessed at pretreatment, post-treatment, and at a 6-month follow-up for functional status related to
    - Pain
    - Depression
    - Negative and positive affect
    - Coping skills
  - Reduced pain and depression
  - Increased positive affect

CBT

Botella et al. (2013). Virtual reality in the treatment of Fibromyalgia: A pilot study. *CyberPsychology, Behavior & Social Networking*, 16, 215-223.



This year itself the third paper it was published was by Botella and his associates would talk about the effectiveness of virtual reality as an adjunct to cognitive behavior therapy. Now, cognitive behavior therapy is well known therapeutic technique to psychologists.

But then, virtual reality and CBT this being now put together is an interesting construct. Now, the sessions of group CBT with adoptive virtual environment that contained a specific content for developing relaxation and mindfulness skill was used here. The patients were assessed at pretreatment post treatment and of course, after 6 months follow up. With respect to pain depression, negative and positive affect and coping skills.

What was found was that reduction in the pain and depression was there and also there was an increase in the positive affect. So, usually know this would look very interesting very fascinating to people working in the clinical domain to see how virtual reality can be used as a technology.

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The slide is titled "Virtual Reality & Psychology" in a bold, black font at the top center. Below the title is a horizontal red line. There are two bullet points: the first is "Evidence-based treatments (EBT) for PTSD in Operation Enduring Freedom/ Operation Iraqi Freedom (OEF/OIF) military service personnel" and the second is "VR aided interventions in veteran healthcare systems". At the bottom center, there is a red button with the text "VR aided interventions in veteran healthcare systems" in white. Below the button, there is a small citation: "Kramer et al. (2013). Veteran perceptions of virtual reality to assess and treat posttraumatic stress disorder. *CyberPsychology, Behavior & Social Networking*, 16, 293-301."

Another study published this year itself is by Kramer by its associates who talks about evidence based treatment for PTSD. And remember the group that he has studied is basically the military service personnel, who participated in operation Iraq freedom. Here, a virtual reality has been used as an 8 for intervention in the veteran health care system. So, how psychological care, how mental health issues how psychopathology and how virtual reality can be now put together under this same umbrella; that is an interesting demonstration.

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## Virtual Reality & Psychology

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Sn	Year	Constructs	Problem
6	2012	Teaching	Heuristic tool for understanding and teaching a key psychoanalytic concept, transference
7	2012	Anxiety	Association between explicit conditioning effects and subsequent avoidance behaviour

Last year, that is 2012 2 papers were published where virtual reality has been used. 1, where the heuristic tool for understanding and teaching key concept in psychology, what that is transference. That was examined and the other paper where anxiety has been studied which talks about, association between explicit conditioning effect and subsequent avoidance behavior by human subjects.

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## Virtual Reality & Psychology

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- Use of an online virtual world--Second Life®--as a heuristic tool for understanding and teaching a key psychoanalytic concept— transference

Teaching

Gorrindo, T. & Groves, J.E. (2012). The psychodynamics of transference-- A virtual reality model. *American Journal of Psychotherapy*, 66, 151-163.

2012, the first paper that was published was by Gorrindo and Groves, who talked about the use of an online virtual world that is second life; most of you must be aware of it. How that can be used as heuristic tool to make people understand that key concept of psychoanalysis that is, transference. So, that is an interesting thing how virtual reality can be used for that.

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## Virtual Reality & Psychology

- Maintenance of anxiety disorders
- Fear conditioning leads to avoidance
- Association between explicit conditioning effects and subsequent avoidance behaviour

Substantial conditioning

Glotzbach et al. (2012). Contextual fear conditioning predicts subsequent avoidance behaviour in a virtual reality environment. *Cognition & Emotion*, 26, 1256-1272.

The other paper was by Glotzbach and his associates, who talks about the maintenance of anxiety disorder, primarily it is now talking about conditioning.

So, fear conditioning how it leads to avoidance and using virtual reality they found association between explicit conditioning effect and subsequent avoidance behavior. Remember the best part of virtual reality is that you do not know interact in real life with that situation. It is all in the lab set up in very very controlled and safe environment but, that can be no give an impression to the participant as if 1 is really experiencing at.

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## Virtual Reality & Psychology

Sn	Year	Constructs	Problem
8	2011	Parkinson's disease	Improve motor performance in people with Parkinson's disease
9	2011	Stroke	Rehabilitation of upper limb skills of children with neurological impairment
10	2011	PTSD	Treatment of PTSD
11	2011	Traumatic brain injury	Attention exercises using virtual environments
12	2011	PTSD	Exposure therapy is an evidence-based treatment for PTSD

2011, there were 5 papers to dealing with posttraumatic stress disorder, 1 dealing with the stroke 1 dealing with Parkinson's disease and 1 dealing with traumatic brain injury ma and associates they worked on the kinematics of the Parkinson's disease patients and they were now trying to understand the practicing effect of reach in the virtually moving targets.

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## Virtual Reality & Psychology

- Practising to reach virtual moving targets
- This would improve motor performance in people with Parkinson's disease
- Reaching for fast-moving virtual balls with the dominant hand
- Success rates and kinematic data for acceleration phase
  - movement time
  - peak velocity
  - % of movement time
- pre and post test data were recorded to determine the immediate transfer effects

### Parkinson's, Kinematics

Ma et al. (2011). Effects of virtual reality training on functional reaching movements in people with Parkinson's disease: a randomized controlled pilot trial. *Clinical Rehabilitation*, 25, 892-902.

So you have a virtually moving target and people with Parkinson disease. So, you will have lots of difficulty moving their arm, how they try to reach the target. And they found that at using virtual reality they can study what would improve motor performance in people who suffer from Parkinson disease. Now, reaching for faster moving virtual balls with the dominant hand that was the task here and what was observed was that the success rate and the kinematic data for acceleration phase. All movement time peak velocity and percentage of movement time with the pre and post test data showed that, there is an immediate transfer effect.

So fantastic research are on Parkinson's diseased patients where you use virtual reality for neurorehabilitation.

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## Virtual Reality & Psychology

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- Stroke
- VR systems for rehabilitation of upper limb skills of children with neurological impairment

Neurorehabilitation

Galvin et al. (2011). Does intervention using virtual reality improve upper limb function in children with neurological impairment: A systematic review of the evidence. *Brain Injury*, 25, 435-442.

Another study published in 2011 was by Galvin and his colleagues, where stroke patients were examined and this very study actually looked at virtual reality systems for rehabilitation of upper limb. Skills of children who had neurological impairments; once again you find virtual reality neurorehabilitation for the stroke patients.

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## Virtual Reality & Psychology

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- Soldiers posted in Iraq & Afghanistan
- VR-graded exposure therapy (VR-GET) versus treatment as usual (TAU) for PTSD in Active Duty military personnel with combat-related PTSD

PTSD

McLay et al. (2011). A randomized, controlled trial of virtual reality-graded exposure therapy for post-traumatic stress disorder in active duty service members with combat-related post-traumatic stress disorder. *CyberPsychology, Behavior & Social Networking*, 14, 223-229.

PTSD of course, right now we discussed 1 paper another paper is by McLay and his associates who worked on soldiers who were posted in Iraq and Afghanistan. And they were working on the treatment of the PTSD. What they found was that the virtual reality graded exposure therapy and the usual treatment know that is the t a u for PTSD. How

know combat related stress and PTSD can be handled using posttraumatic stress disorder; so, great clinical application of the virtual reality technology.

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The slide is titled "Virtual Reality & Psychology" and features a list of bullet points. A red bar at the bottom contains the word "Neurorehabilitation".

- Traumatic brain injury (TBI)
- 3-dimensional cancellation exercises over two days in an interactive virtual environment
- Minimal distractions
- Integration of both visual and haptic (tactile) stimuli
- Attention exercises using virtual environments
- Beneficial for inpatients with severe TBI

Neurorehabilitation

Larson et al. (2011). Tolerance of a virtual reality intervention for attention remediation in persons with severe TBI. *Brain Injury*, 25, 274-281.

Traumatic brain injury patients were also studied by Larson and his associates. This paper was published in 2011, where the 3 dimensional cancellation exercise now cancellation test is something it is known to all psychologist but, 3 dimensional cancellation exercise over 2 days in an interactive virtual environment was the demand in this case. With minimal distraction and this study also looked at the integration of the visual and the haptic stimuli.

Once again the findings have great relevance for neurorehabilitation. What they found was at there was there is an attention exercise using virtual environment that can be done. And of course, now it is very beneficial for the inpatients who come with the traumatic brain injury.

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### Virtual Reality & Psychology

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- Exposure therapy is an evidence-based treatment for PTSD
  - Limited research evaluating its effectiveness with active duty service members
- Examines the effectiveness of virtual reality exposure therapy (VRE) for active duty soldiers
  - These soldiers were seeking treatment following a deployment to Iraq or Afghanistan

PTSD

Reger et al. (2011). Effectiveness of virtual reality exposure therapy for active duty soldiers in a military mental health clinic. *Journal of Traumatic Stress*, 24, 93-96.

Reger and his colleagues now published another paper in 2011 where, once again the exposure therapy in PTSD treatment was being examined. And now there are of course, very limited research that evaluates the effectiveness know in the active duty service members. So, this very therapy the VRE is the virtual reality exposure therapy, in the active duty soldiers were was done and once again know the soldiers who were posted in Iraq and Afghanistan, they were the participants of the very study. So, the health care system both in the civil and defense sector; both have no benefit of the usage of virtual reality in psychology.

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### Virtual Reality & Psychology

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Sn	Year	Constructs	Problem
13	2010	High-level social phenomena	Real behavior in virtual environments
14	2010	Dissociation	Effects of virtual reality on dissociative experience and the sense of presence
15	2010	PTSD	Combat stressors in virtual reality

In 2010, 3 papers were published using virtual reality technology 1 working on the high level social phenomena second 1dissociation and the third on PTSD.

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**Virtual Reality & Psychology**

- Use of simple video-game-based virtual environments (VEs) for psychological research on real-world behaviour
- Likelihood of helping under time pressure and the bystander effect

Video games

Kozlov, M.D. & Johansen, M.K. (2010). Real behavior in virtual environments: Psychology experiments in a simple virtual-reality paradigm using video games. *CyberPsychology, Behavior & Social Networking*, 13, 711-714.

Now Kozlov and Johansen they worked on the simple video game based virtual environment. And they were trying to look at psychological research on real world behavior and the likelihood of helping others when you have your own time pressure and when you have the bystander. What type of likelihood it has now on your helping behavior that was being examined here.

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**Virtual Reality & Psychology**

- Effects of virtual reality (VR) on dissociative experience and the sense of presence
- Dissociative experience
  - Depersonalization
  - Derealization

Dissociation

Aardema et al. (2010). Virtual reality induces dissociation and lowers sense of presence in objective reality. *CyberPsychology, Behavior & Social Networking*, 13, 429-435.

So, that is another interesting study another study publishes in 2010 was by Aardema and his associates which was on the effect of virtual reality on dissociative experience and the sense of presence. And here both know depersonalization and de-realization both of these dissociative experience were examined.

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The slide is titled "Virtual Reality & Psychology" and features a list of four bullet points. A red bar at the bottom contains the text "PTSD". Below the bar is a citation.

- PTSD in a 30-year-old soldier
- Military Contingent in Iraq who narrowly escaped death three times
- Combat stressors in virtual reality (VR)
- Supplemented with behavioral training consisting of desensitization of an aversive reaction to contact with a weapon at a shooting range

PTSD

Tworus, R., Szymanska, S. & Ilnicki, S. (2010). A soldier suffering from PTSD, treated by controlled stress exposition using virtual reality and behavioral training. *CyberPsychology, Behavior & Social Networking*, 13, 103-107.

In 2010, another study that came forward studied the PTSD in a 30 year old soldier. And here the military contingent know who had gone to Iraq and had a very narrow escape to death this soldier was specifically chosen for the study because; thrice during his posting in Iraq he narrowly escaped death. And here once again virtual reality was used to examine combat stressors. And know this was supplemented with behavioral training that consisted of desensitization, aversive reaction all types of things no contact with weapon in the shooting range and so for.

A beautiful way of know looking after the mental health of individual soldiers, who have experienced such type of situations in their profession.

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Importance	
Eye-tracking	VR
<ul style="list-style-type: none"> <li>• Anxiety</li> <li>• Attention</li> <li>• Autism Spectrum Disorder</li> <li>• Visual perception</li> <li>• Belief</li> <li>• Working memory</li> <li>• Social phobia</li> <li>• Depression</li> <li>• Perceptual-motor processes</li> <li>• Problem solving</li> <li>• Decision Making</li> </ul>	<ul style="list-style-type: none"> <li>• Sexual deviation</li> <li>• Social skills</li> <li>• PTSD</li> <li>• Anxiety</li> <li>• Heuristics</li> <li>• Parkinson's disease</li> <li>• Stroke</li> <li>• PTSD</li> <li>• Traumatic brain injury</li> <li>• Dissociation</li> </ul>

If you look at the importance of these 2 technologies in psychology, right now what we saw was eye tracking being used for: anxiety, attention, autism spectrum disorder, visual perception belief, working memory, social phobia, depression problem, solving decision making, perceptual motor processes. Virtual reality being once again used for PTSD, anxiety, Parkinson's disease, dissociation, traumatic brain injury of course, sexual deviation and social skills.

You find a great degree of know significance of these 2 technology on this examination of human behavior. This was actually an attempt to take you right from the first lecture where I talked to you about how psychology we know as a discipline. So, right from looking at the philosophical influence on psychology to psychology becoming science of behavior the whole process of systematic and scientific study exploration, examination of human behavior to the last lecture, where we have come to the cutting technology being used in psychology.

So, with this now we complete this whole discussion on the wide range of topics pertaining to psychology. And this is the last lecture of this very course what is named as selected topics in psychology.