

# Metaphors as Analytic Tools to Dialogue between Theory and Methods

**Dr. Andreas Gegenfurtner**

Institut für Qualität und Weiterbildung • Technische Hochschule Deggendorf

SIG17 • Cambridge • 27 August 2018



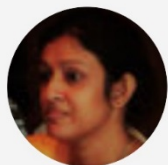
gefördert durch den Bund-Länder-  
Wettbewerb "Aufstieg durch Bildung:  
offene Hochschulen"



## Discussion in ResearchGate

Question

Asked 6 months ago



**Onalie Dissanayake**

Independent Researcher

Which research method do you prefer?  
Quantitative, qualitative or Mixed? Can you give the reason for your answer please?

I would like to know the use of research methods and the purpose they are used by different researchers and the different purposes



## Discussion in ResearchGate



David L Morgan

Added an answer

6 months ago

As usual, there is a lot of emphasis here on the how the method must fit the question. But I believe that it is just as likely that people ask questions that fit their preferred methods. After all, once you have built up expertise in qualitative methods, are you going to abandon that because a particular question points to the use of a random sample survey -- or wouldn't it make more sense to adjust your question to something that matches the skills you already have? (And of course the same is true of making a radical switch from quantitative methods to qualitative.)

I think it would be hard to find a research topic so narrow that it could only be addressed by qualitative, quantitative, or mixed methods. Instead, I think that people pursue an inter-connected search for satisfying kinds of questions and satisfying kinds of answers, where the latter depends on the kind of method that you use.



Recommended

Share

2 Recommendations



## ▶ Visual Expertise in Medicine



**“Having a good eye”**



## Metaphors in learning research

**“Metaphors are the most primitive, most elusive, and yet amazingly informative objects of analysis“**

Sfard, 1998, p. 4

see also Paavola, Lipponen, & Hakkarainen, 2002





## ► A metaphorical mapping

	<b>Activation</b>	<b>Detection</b>	<b>Inference</b>	<b>Practice</b>
Indicators of visual expertise	Neurophysiologic activity	Eye movements	Verbal reports	Representational practices
Unit of analysis	Individual	Individual (social)	Individual and social	Sociotechnical
Place of visual cognition	Neural network system	Optic system	(Distributed) memory system	Activity system
Analytic time span	Milliseconds to seconds	Seconds	Minutes to few hours	Minutes to decades
Associated methodology	Cognitive neuroscience	ROC analysis; eye tracking methodology	Protocol analysis; interviews	Ethnomethodology, ethnography



# Activation Metaphor



## Visual Expertise as Activation

**“Information is stored in neural networks in the brain, and (...) human behavior arises from extremely complex communication between neurons in these networks and also between separate networks or assemblies”**

Sauseng & Klimesch, 2008, p. 1003





# Subjective task value



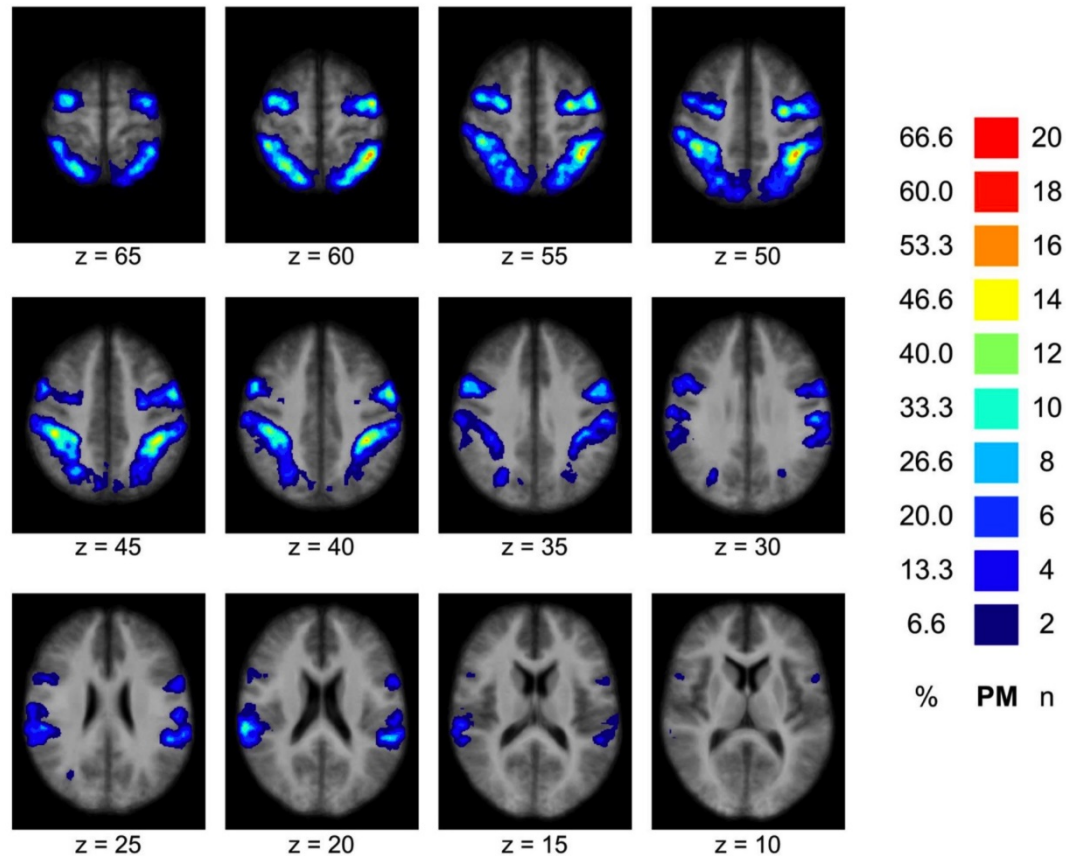
## The Neural Implementation of Surgical Expertise Within the Mirror-Neuron System: An fMRI Study

*Ellen Kok<sup>1\*</sup>, Anique B. De Bruin<sup>1</sup>, Koos van Geel<sup>1</sup>, Andreas Gegenfurtner<sup>1,2</sup>, Ide Heyligers<sup>1,3</sup> and Bettina Sorger<sup>4</sup>*

<sup>1</sup> School of Health Professions Education, Maastricht University, Maastricht, Netherlands, <sup>2</sup> Institut für Qualität und Weiterbildung, Technische Hochschule Deggendorf, Deggendorf, Germany, <sup>3</sup> Department of Orthopedic Surgery, Orbis Medisch Centrum, Sittard, Netherlands, <sup>4</sup> Department of Cognitive Neuroscience, Maastricht University, Maastricht, Netherlands



# ▶ Mirror neuron system activation



**FIGURE 2** | Result of the MNS definition. The figure displays a probability map of the MNS based on all individually ( $n = 30$ ) defined MNS-NOIs demonstrating the spatial overlap of the individual MNS definitions across participants (precentral and parietal areas). The probability map is overlaid to the mean of all individual anatomical data sets. Remarks: n—number of participants showing spatial overlap of the MNS in the particular brain region; %—percentage of participants demonstrating spatial overlap in the particular brain region.

## ► Visual Expertise as Activation

- Indicator: neurophysiologic activity
- Level of analysis: individual
- Place of visual expertise: neural network system
- Analytic time span: Milliseconds to seconds
- Associated methodology: Cognitive neuroscience (fMRI, EEG)

Kok, De Bruin, Van Geel, Gegenfurtner, Heyligers, & Sorger, 2018  
Gegenfurtner, Kok, Van Geel, De Bruin, & Sorger, 2017



# Detection Metaphor



## Visual Expertise as Detection

**“determining whether a simple, featurally defined stimulus is present in, or absent from, the visual field”**

Smith & Ratcliff, 2009, p. 283



## Fixations

Canadian Journal of Emergency Medicine



CAEP | ACMU




[Article](#)

[Supplementary materials](#)

[Metrics](#)

First View

### A new way to look at simulation-based assessment: the relationship between gaze-tracking and exam performance

Adam Szulewski  <sup>(a1)</sup>, Rylan Egan <sup>(a2)</sup>, Andreas Gegenfurtner  <sup>(a3)</sup>, Daniel Howes <sup>(a1)</sup>, Gerhard Dashi <sup>(a4)</sup>, Nick C. J. McGraw <sup>(a5)</sup>, Andrew K. Hall <sup>(a1)</sup>, Damon Dagnone <sup>(a1)</sup> and Jeroen J. G. van Merrienboer <sup>(a6)</sup> 





## ► Order and duration of fixations within 1 minute

**Figure 1:** A third year residents' gaze fixations within the first minute of a simulation. The numbers represent the order in which the resident looked at each area of interest and the size of the circle represents the relative time spent fixating on each of these points.



## ► Visual Expertise as Detection

- Indicators of visual expertise: Eye movements
- Level of analysis: individual
- Place of visual cognition: Optic system
- Analytic time span: Seconds
- Associated methodology: Eye tracking; ROC analysis

Szulewski, Egan, Gegenfurtner, Howes, Dashi, McGraw, Dagnone, Hall, & Van Merriënboer, in press  
Hauser, Gegenfurtner, Hutzler, Reuter, Gruber, Holmqvist, & Mottok, 2018



# Visual Expertise as Inference



## Visual Expertise as Inference

**“(...) is largely a matter of cognitive inference. That is, given a set of findings (perceptual features), one has to determine which diseases are consistent with those findings. If more than one disease is consistent, then one either looks further, (...) or suggests additional medical tests to discriminate among the possibilities“**

Lesgold, 1988, p. 336



# ► Visual Expertise as Inference

Computers & Education 113 (2017) 212–225



Contents lists available at [ScienceDirect](#)

## Computers & Education

journal homepage: [www.elsevier.com/locate/compedu](http://www.elsevier.com/locate/compedu)



## Effects of eye movement modeling examples on adaptive expertise in medical image diagnosis



Andreas Gegenfurtner <sup>a, \*</sup>, Erno Lehtinen <sup>b</sup>, Halszka Jarodzka <sup>c, d</sup>, Roger Säljö <sup>e</sup>

<sup>a</sup> Technische Hochschule Deggendorf, Germany

<sup>b</sup> University of Turku, Finland

<sup>c</sup> Open University of the Netherlands, The Netherlands

<sup>d</sup> Humanities Lab, Lund University, Sweden

<sup>e</sup> University of Gothenburg, Sweden



# Coding of verbal data

**Table 1**

Coding scheme and coding examples of verbal data.

Category	Code	Protocol segment
Technology dimension		
Interacting with the visualization	T-IV	"Next let's move to these axillary eh axial images and let's get that larger again"
Commenting on the visualization	T-CV	"So I just have to think then which way around these images were"
Cognitive comprehension dimension		
Selecting data		
Selecting relevant features in technical terms	S-RT	"Now I see this high uptake of tracer here"
Selecting relevant features in vernacular terms	S-RV	"There is some red thing here"
Selecting irrelevant features in technical terms	S-IT	"This is the ventricle wall of the upper stomach"
Selecting irrelevant features in vernacular terms	S-IV	"This looks like the stomach"
Organizing data		
Organizing relevant features	O-RF	"This is not the heart because heart is not seen so this has to be tumor also"
Organizing irrelevant features	O-IF	"Those could be the bowel, those black spaces"
Integrating data with prior knowledge		
Retrieving biomedical/declarative knowledge	I-RB	"Why would the tumor look like that"
Retrieving clinical/experiential knowledge	I-RC	"It's too big compared to what I have seen in other patients before"
Metacognitive comprehension dimension		
Using heuristic strategies	M-HS	"In the usual way we'll start from the transaxial slices looking from the top downward"
Using control strategies	M-CS	"I would hesitate to claim that this is cancer. It could be. But I'm not sure"
Using learning strategies	M-LS	"I guess this is where I would call XX to ask him what he thinks about this"
Problem solution dimension		
Stating a correct problem solution	P-SC	"Mediastinum is positive for cancer both sides"
Stating an incorrect problem solution	P-SI	"This is prostate cancer"





## ▶ Visual Expertise as Inference

- Indicators of visual expertise: Verbal reports
- Level of analysis: individual and social
- Place of visual cognition: (Distributed) memory system
- Analytic time span: Minutes to few hours
- Associated methodology: Protocol analysis; interviews

White, Braund, Howes, Egan, Gegenfurtner, Van Merriënboer, & Szulewski, 2018  
Gegenfurtner, Lehtinen, Jarodzka, & Säljö, 2017



# Visual Expertise as Practice



## Visual Expertise as Practice

**“A percept is something that lives and becomes,  
it possesses a biological complexity which is not be explained  
simply in terms of the computations by a neural network  
classifying on the basis of very simple mechanisms”**

Carsetti, 2004, p. 307



## Visual Expertise as Practice

85	Oliver	no. (.) [can you see it <u>there</u> ? (0.4) what carl <sub>ɿ</sub> pointed out <sub>ɿ</sub> (0.3)
86		[( <i>highlights the pleural line</i> )]
87	Ella	( <i>moves her index finger over the image</i> )
88	Oliver	black lines are <u>not</u> <sub>ɿ</sub> accepted <u>white</u> <sub>ɿ</sub> lines are accepted. (0.4)
89		( <i>highlights the pleural line</i> )
90		<u>tha:t</u> 's <sub>ɿ</sub> (.) whi:te <sub>ɿ</sub>
91	Ben	°mh yeah and that is black° (0.2)
92		( <i>highlights a structure next to the pleural line with his index finger</i> )
93	Oliver	<u>black</u> . (.) ya [°ya° (.)
94	Carl	[m (.) m
95	Ella	[( <i>highlights with a pen in her right hand the same structure as Ben</i> )]
96		[that's? <u>black</u> <sub>ɿ</sub>
97	Ben	yes it's a °black [li:ne°.
98		[( <i>highlights the structure again</i> )]
99	Ella	[and that has to be <u>whi</u> [te (0.6)
100	Oliver	[yes.
101	Ella	[( <i>highlights the pleural line with a pen in her right hand</i> )]
102		[°and° the <u>white</u> is over he:re. (0.3)
103	Oliver	°ya:h [ya° (.)
104	Ben	[it's very clear



## ► Visual Expertise as Practice

- Indicators of visual expertise: Representational practices
- Level of analysis: Sociotechnical
- Place of visual cognition: Activity system
- Analytic time span: Minutes to decades
- Associated methodology: Ethnomethodology; ethnography



# Discussion





## ▶ A metaphorical mapping of visual expertise

	<b>Activation</b>	<b>Detection</b>	<b>Inference</b>	<b>Practice</b>
Indicators of visual expertise	Neurophysiologic activity	Eye movements	Verbal reports	Representational practices
Unit of analysis	Individual	Individual (social)	Individual and social	Sociotechnical
Place of visual cognition	Neural network system	Optic system	(Distributed) memory system	Activity system
Analytic time span	Milliseconds to seconds	Seconds	Minutes to few hours	Minutes to decades
Associated methodology	Cognitive neuroscience	ROC analysis; eye tracking methodology	Protocol analysis; interviews	Ethnomethodology, ethnography



## Discussion in ResearchGate

Question

Asked 6 months ago



**Onalie Dissanayake**

Independent Researcher

Which research method do you prefer?  
Quantitative, qualitative or Mixed? Can you give the reason for your answer please?

I would like to know the use of research methods and the purpose they are used by different researchers and the different purposes



## Discussion in ResearchGate



David L Morgan

Added an answer

6 months ago

As usual, there is a lot of emphasis here on the how the method must fit the question. But I believe that it is just as likely that people ask questions that fit their preferred methods. After all, once you have built up expertise in qualitative methods, are you going to abandon that because a particular question points to the use of a random sample survey -- or wouldn't it make more sense to adjust your question to something that matches the skills you already have? (And of course the same is true of making a radical switch from quantitative methods to qualitative.)

I think it would be hard to find a research topic so narrow that it could only be addressed by qualitative, quantitative, or mixed methods. Instead, I think that people pursue an inter-connected search for satisfying kinds of questions and satisfying kinds of answers, where the latter depends on the kind of method that you use.



Recommended

Share

2 Recommendations



The background of the slide is a photograph of a modern, multi-story building with a grey facade and large windows. Several young trees with green leaves are planted in front of the building. A group of people is walking on a path to the right. A semi-transparent grey rectangle is overlaid on the middle of the image, containing the text.

**Thank you very much  
for your kind interest**

Contact information  
**[andreas.gegenfurtner@th-deg.de](mailto:andreas.gegenfurtner@th-deg.de)**

