

# Expertise and expert performance

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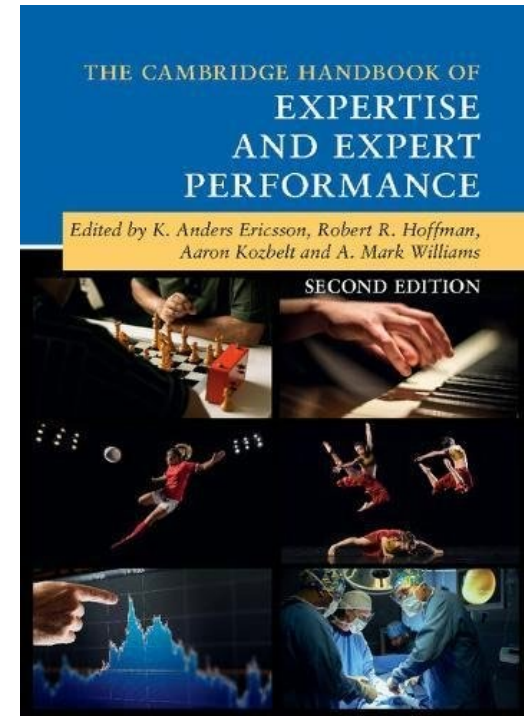


A photograph of two men in a workshop. The man on the left is younger, with short brown hair, wearing a dark blue button-down shirt. He is smiling and looking down at a metal piece he is working on with a tool. The man on the right is older, with grey hair, also wearing a dark blue button-down shirt. He is looking at the younger man's work with a focused expression. The background is a workshop with various tools and equipment visible.

# Expertise = ?



K. A. Ericsson



**Special Issue 2014:** Acquiring Expertise: Ability, Practice, and Other Influences. *Intelligence*, 45(4).

**Special Issue 2014:** Guest-Editors: H. Gruber and H. Stoeger. Cultures of Expertise: The Social Definition of Individual Excellence, *Talent Development & Excellence*, 6(1).



## **Listening to experts: Andris Nelsons**

Mahler, 6th Symphony

With The Vienna Philharmonic, Salzburg Festival 2020

Score with annotations



# Overview

Making easy things difficult

What you should know about expertise

- Superior performance
- Adaptations
- Knowledge restructuring and case processing
- Deliberate practice
- Becoming a member

What to do? Some examples





# Making easy things difficult



# The development of expertise

- Little evidence that geniuses, experts, excellent performers, highly gifted individuals etc. are different by nature
- But they are (and have been for a long period of time) extremely adaptive to ambitious task requirements
- And they were engaged in long-lasting deliberate practice
- (Some remarkable behavioural peculiarities may be helpful to develop and maintain such practice)
- “99% transpiration, 1% inspiration”

## **Expertise: Challenges and complexities**

Reproducible superior performance in a domain

- Identify such reproducible superior performance
- Easier in music and the fine art than in many other professions

Dramatic cognitive adaptations

- Memory, skills, routines, speed, flexibility

Acquired by deliberate practice over a (very) long period of time



The background is a collage of various words related to expertise, such as 'Know-how', 'Knack', 'Proficiency', 'Skill', 'Ability', and 'Expertise'. The word 'Expertise' is prominently displayed in a large, dark red serif font, tilted diagonally across the center of the image. Other words are visible in different colors and orientations, creating a layered effect.

# Expertise

What you should know about  
expertise



# Superior performance





# Adaptations





# Adaptions during the acquisition of expertise (Gruber et al., 2010)

## Plasticity

- Cognitive
- Motor
- Physiological
- Neural





# Adaptations during the acquisition of expertise

## cognitive

- Knowledge encapsulation
- Experience = dynamic memory

## motor - physiological - neuronal

- Different rotation of forearm
- Change of lung capacity
- Change of functional brain activities (and even brain structure)

Gruber, H., Jansen, P., Marienhagen, J., & Altenmüller, E. (2010). Adaptations during the acquisition of expertise. *Talent Development & Excellence*, 2, 3-15.



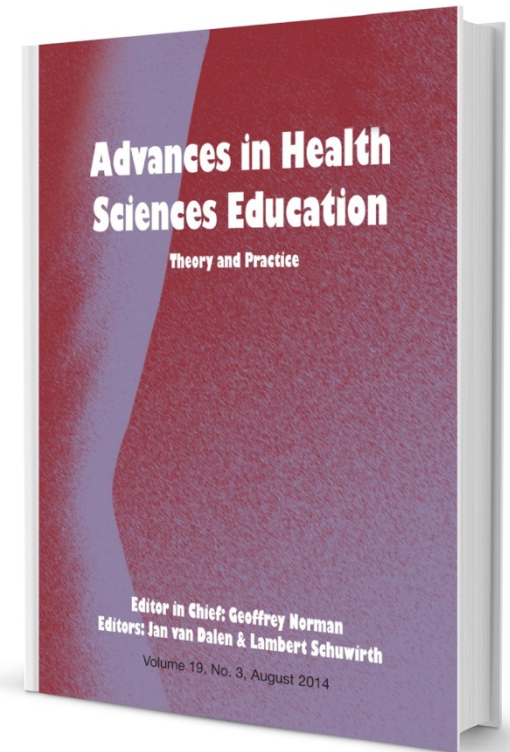
Matthias Schlitte



# Knowledge restructuring

Studies in medicine and child guidance counselling: professionals at different levels of expertise report verbally their experiences with (many different) cases

- Cases are organised in script structures
- Declarative knowledge and professional experience are integrated
- Important for accessing relevant case information

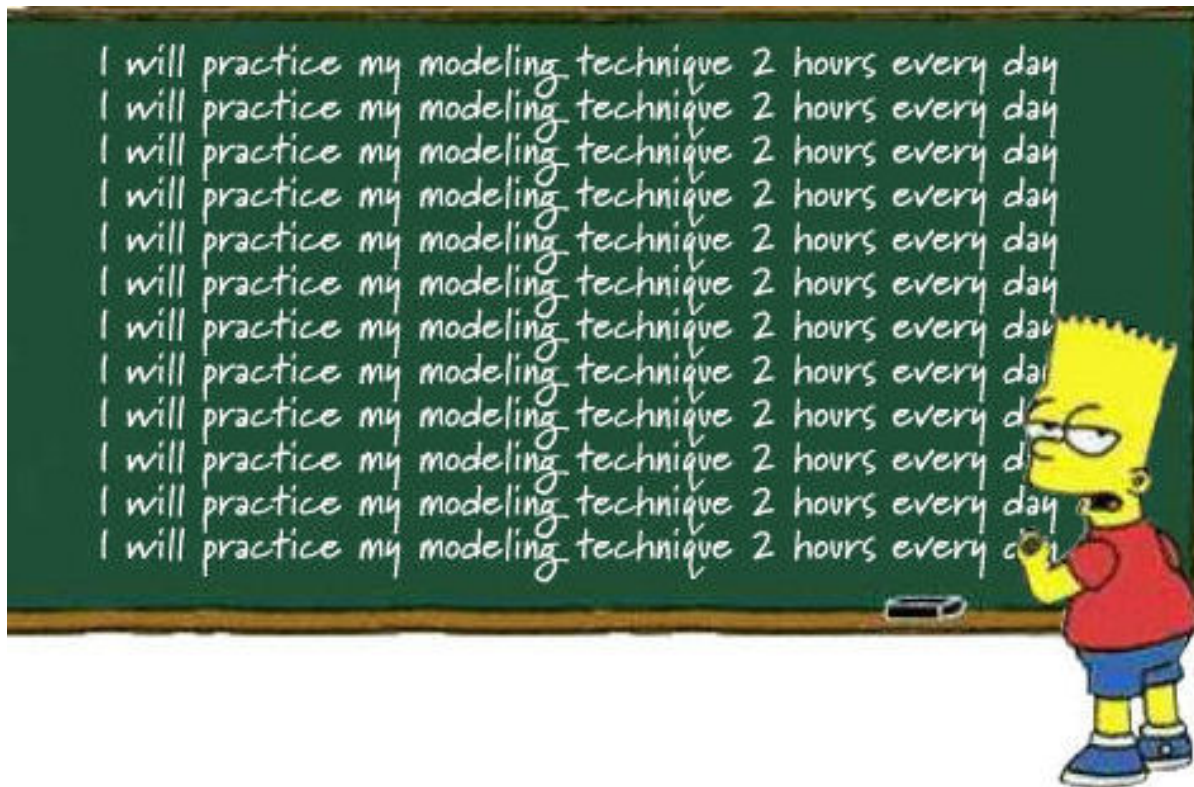




A photograph of an older man with white hair, wearing a plaid shirt, playing a sunburst electric guitar. He is in a music store or workshop, surrounded by various guitars hanging on the wall and on stands. A red semi-transparent banner is overlaid across the middle of the image, containing the text "Deliberate Practice".

# Deliberate Practice

# Setting aims is a starting point ...





# Deliberate practice is necessary ...

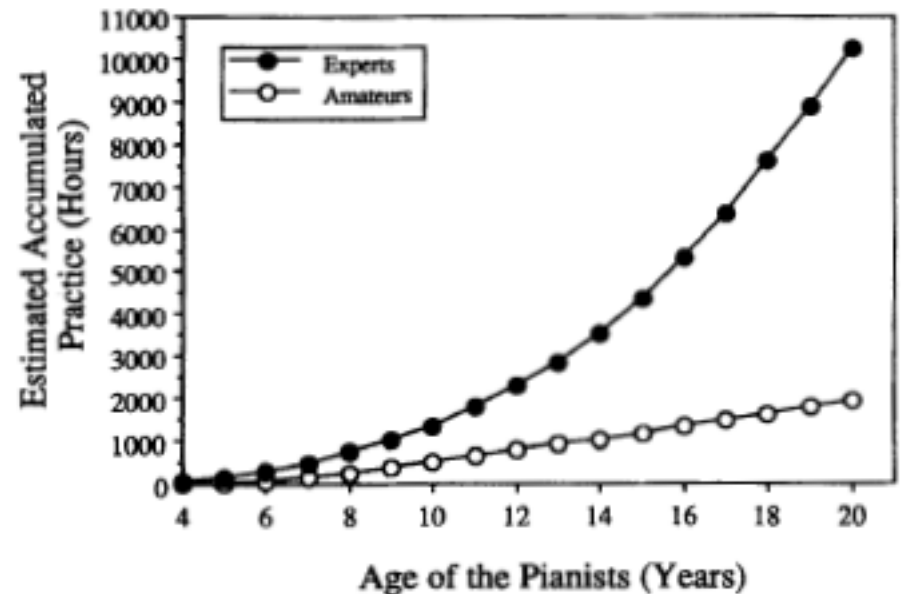


Figure 12. Accumulated amount of practice alone (on the basis of estimates of weekly practice) as a function of age for expert pianists and amateur pianists.

Ericsson, Tesch-Römer, & Krampe (1993)

# Practice activities of conductors



	Start of formal instruction	Weekly duration of practice
Piano	5.8 (Ericsson et al., 1993) 7.8 (Jørgensen, 2001)	26.7 <sup>1</sup> (Ericsson et al., 1993)
Violin	8.0 (Ericsson et al., 1993) 7.1 (Jørgensen, 2001) 5.1 (Kopiez, 1997)	24.3 <sup>1</sup> (Ericsson et al., 1993)
Singing	13.2 (Kopiez, 1997)	10.8 <sup>2</sup> (Kopiez, 1997)
Brass instruments	9.0 (Jørgensen, 2001)	N/A
Woodwind instruments	10.0 (Jørgensen, 2001)	N/A
Guitar	12.0 (Degner et al., 2003)	N/A
Jazz-guitar	20.0 (Degner et al., 2003)	27.2 <sup>2</sup> (Degner et al., 2003)
Conducting	13.9 <sup>3</sup>	13.5

Altenbucher, Haneder, Eiglsperger, & Gruber (in prep.)  
Ritter, Jossberger, Eiglsperger, & Gruber (in prep.)



## Deliberate Practice

- Effortful training activities solely for improving
- Repetition / automatisisation
- Motivational constraints (DP is not [necessarily] fun)

**But:** Who decides which practice is "good practice"?

## The role of the teacher (e.g. in music)

- Offers explicit performance goals
- Provides feedback and opportunities for improvement
- Motivates for practising

**But:** What does this mean?

- (Motivating can be quite aversive)

## Dark (but good) experiences with a teacher (again in music)

- Attila Zoller was famous for to bawl out on his students if they did not behave the way he wanted them to do
- Becoming a central part of the expert community: Zoller decided when [already-expert, prospective top-expert] GP should sit in at a session:

*"If I say 'Play', you have to play. You have to practice another 10 years, before you are allowed to say 'No'."*

- Personalise your playing: GP also was rebuked when playing phrases of other musicians or at least phrases which were associated with these musicians
- This description is not at all in accordance with the picture of a professional teacher who is supportive in nature

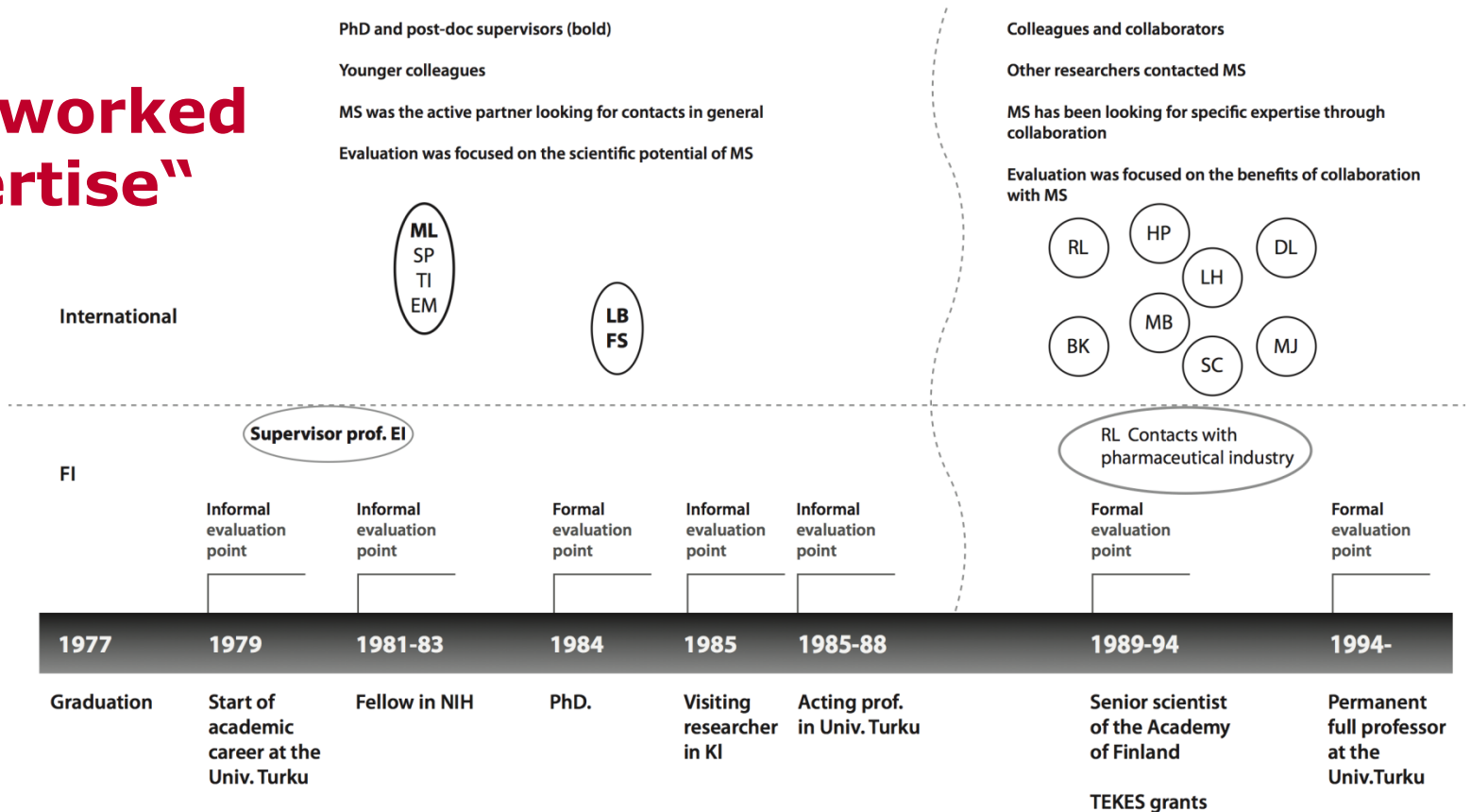


# Becoming a member



## Career line and most important scientific contacts of MS

# „Networked Expertise“



NIH = Visiting Fellow, Clinical Psychobiology Branch, National Institute of Mental Health, USA

KI = Visiting Clinical and Research Associate, Department of Clinical Pharmacology, Huddinge Hospital, Karolinska Institutet, Sweden

Gruber, Lehtinen, Palonen, & Degener (2008), *Psychology Science Quarterly*.



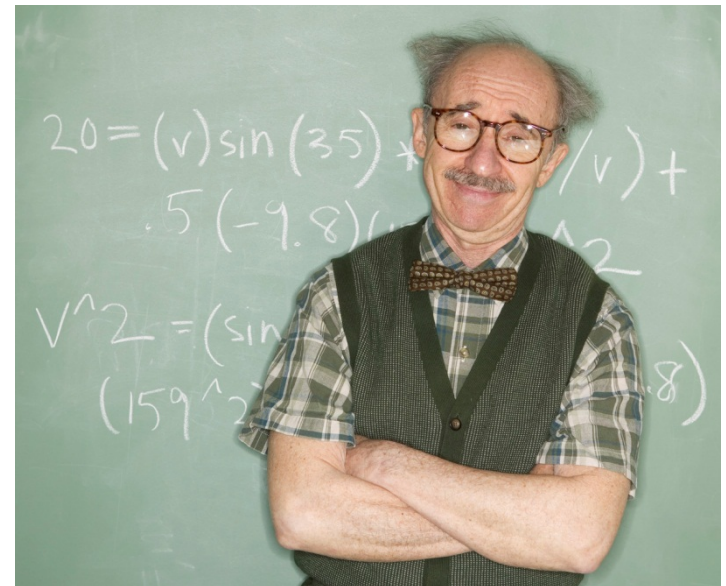
# What to do? Some examples



# Expertise research in educational psychology

Research questions:

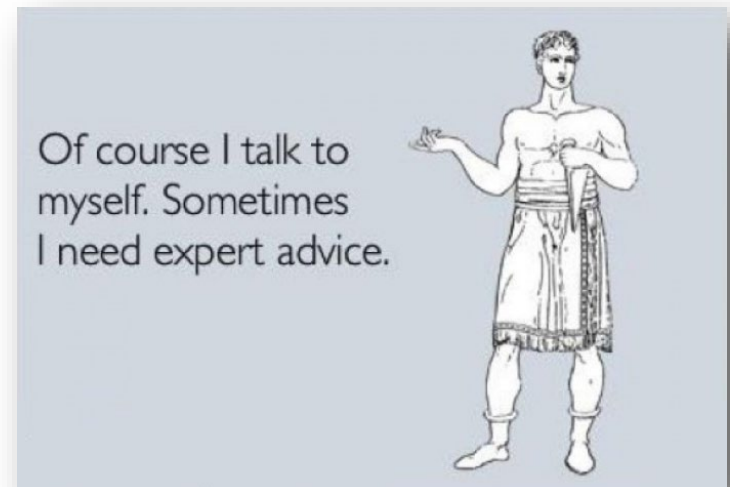
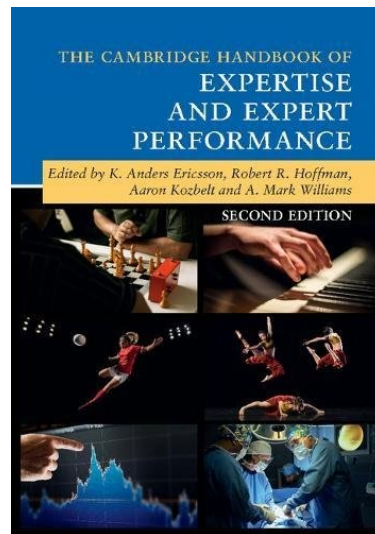
- 1. Task analysis:** what is the optimal approach to a task? (steps, knowledge & skills)
- 2. Error analysis:** Where do errors occur (for all expertise levels!)?
- 3. Educational purpose:** How to teach this task?





# Methods to investigate expertise

- Observations (e.g, Clancey, 2006)
- (Cognitive) Task analysis (e.g., Schraagen, 2006)
- Verbalisations (e.g., Ericsson & Simon, 1980)
- Eye tracking (e.g., Holmqvist, Nyström, Andersson, Dewhurst, Jarodzka, & Van de Weijer, 2011)
- ...for more:



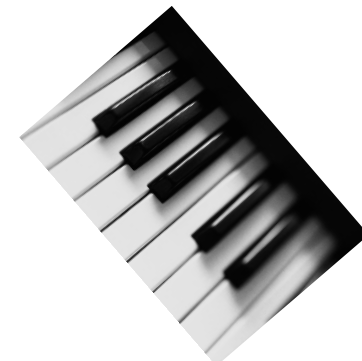
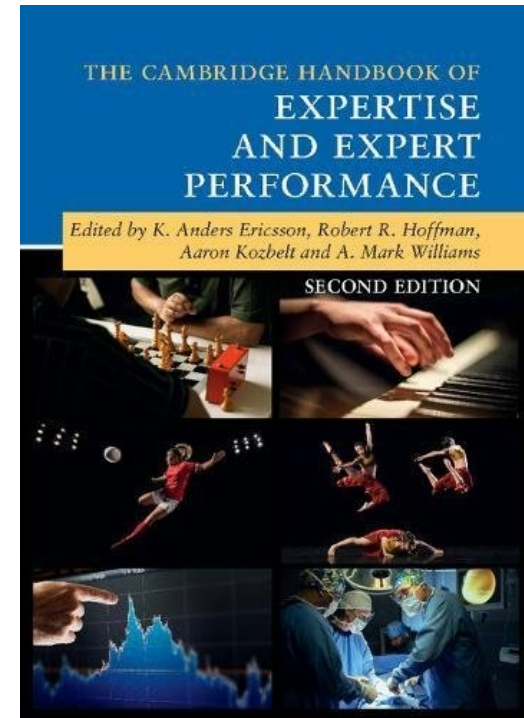
# When to use which method?

Different aspects of expertise:

- Cognitive (e.g., chunking in chess: Chase & Simon, 1973)
- Motor (e.g., playing music: Lehmann & Gruber, 2006)
- Perceptual (e.g., perceptual chunking in chess: Reingold, Charness, Pomplun, & Stampe, 2001; in music: Penttinen & Huovinen, 2009)

## Eye movements and visual expertise in chess and medicine

Eyal M. Reingold and Heather Sheridan



## Visual cognitive processing

- ... density of information / realistic situations / visualisations
- ... many informations, including many irrelevant
- ... relation between thematic relevance and visual saliency often unclear

**Challenge: selection** of relevant visual information

- ... dynamical scenarios
- ... (relevant) informations are elusive
- ... simultaneous appearance of informations

**Challenge: integration** of relevant visual information



# Sculpting



# Observation study

Identify and analyse  
micro processes during  
the sculptural creation



# Theoretical Background

Gaze  
frequency

Stepping  
back

Surface  
structure

Composition  
changes

# Results

## Hypotheses stepping back

- I. During modelling a nude model, experts step back more often than intermediates and novices.
- II. During modelling a nude model, intermediates step back more often than novices.



Number of stepping back in 15 minutes video recording

Expert	Intermediate	Novice
10 times	3 times	2 times



- **Hypotheses surface structure**

- I. The sculpture of experts appears longer open and has a rough surface structure.
- II. The sculpture of novices appears closer at an early stage and has a smooth surface structure.



expert



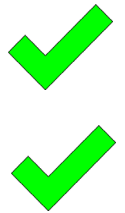
intermediate



novice

## Hypotheses composition changes

- I. Experts do not make huge composition changes at a later point in time.
- II. Novices need to make huge composition changes at a later point in time.



Example of a dramatic composition change



## Mobile eye tracking in the museum

Participants walk around a sculpture and view it  
Attempt to map „Areas of Interest“, as indicated by  
fixations (a measure of eye movements)

A photograph of two men in a workshop. The man on the left is younger, with short brown hair, wearing a dark blue button-down shirt. He is smiling and looking down at a metal piece he is working on with a tool. The man on the right is older, with grey hair, also wearing a dark blue button-down shirt. He is looking at the younger man's work with a focused expression. The background is a workshop with various tools and equipment visible.

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