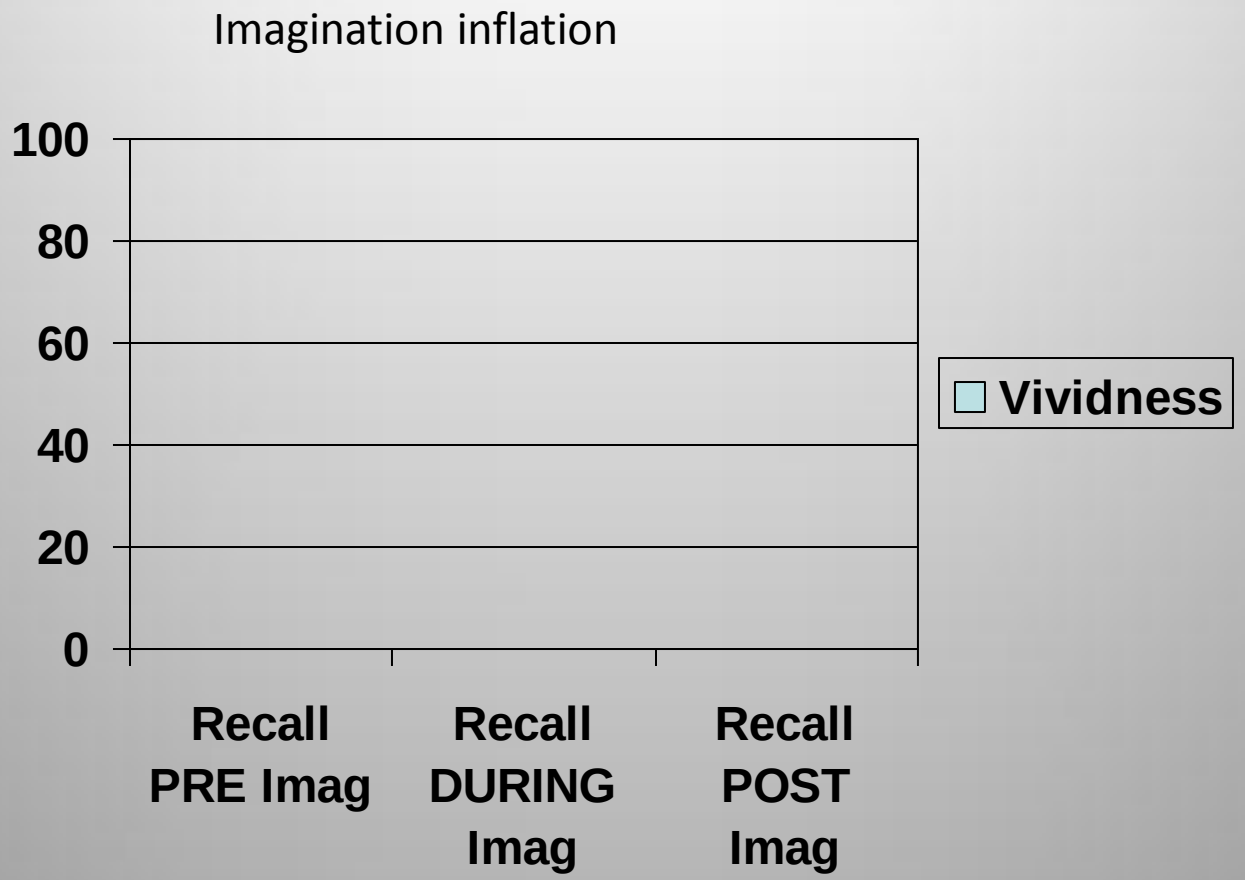
Plasticity of memory in the etiology and treatment of Post Traumatic Stress Disorder.

SITCC
Roma, Oct. 2012
Marcel van den Hout

Computer memory vs. human memory

Plasticity of human memory: a) Memory *inflation*


Imagination inflation
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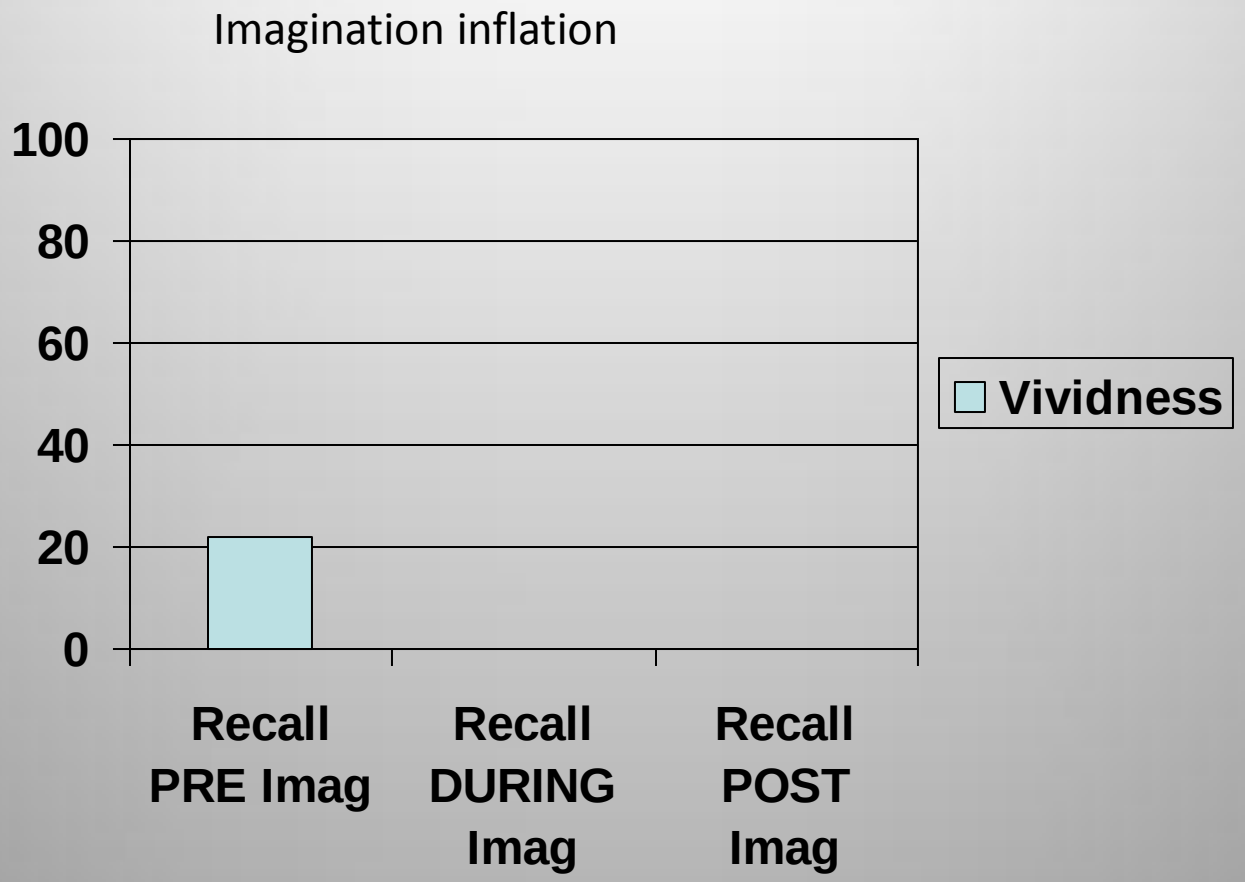
Recall PRE Imag
Recall DURING Imag
Recall POST Imag
Vividness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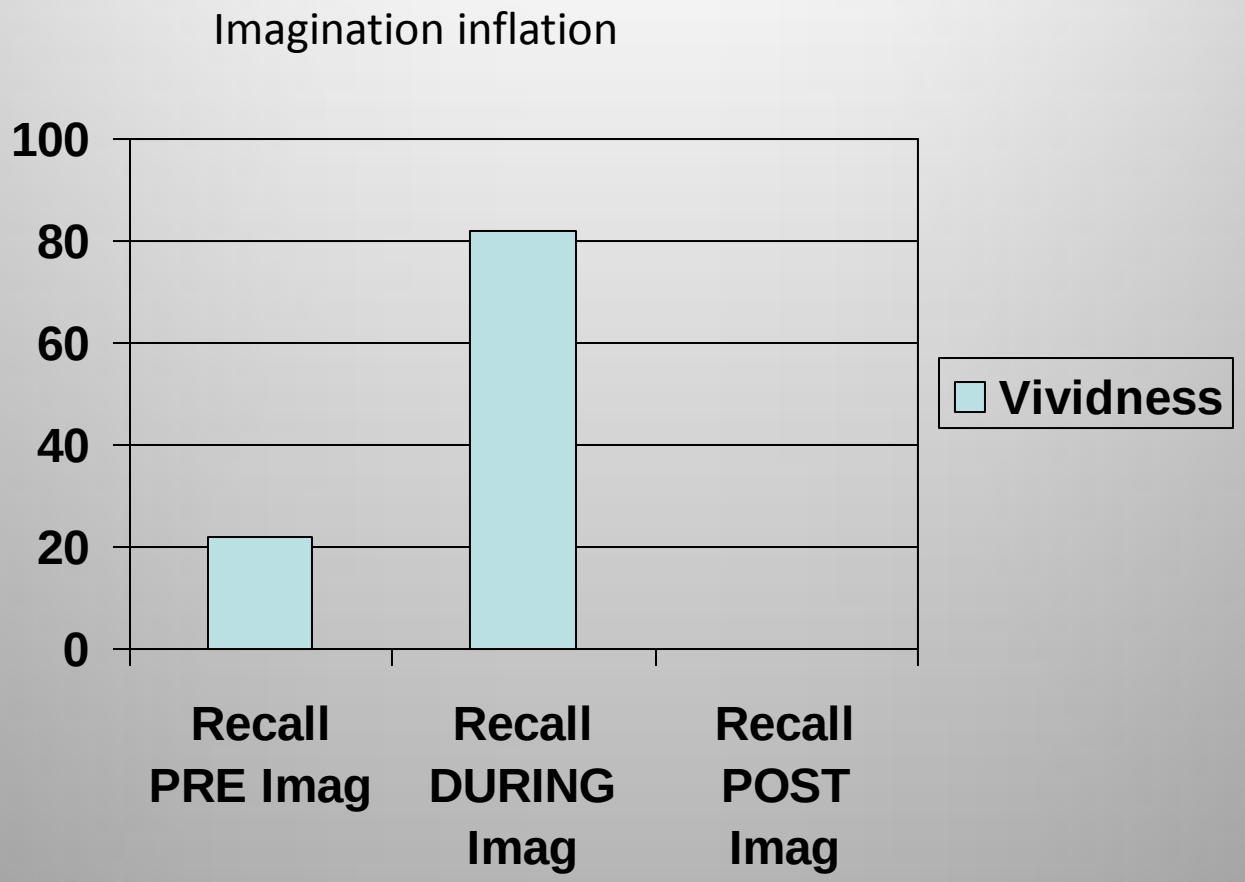
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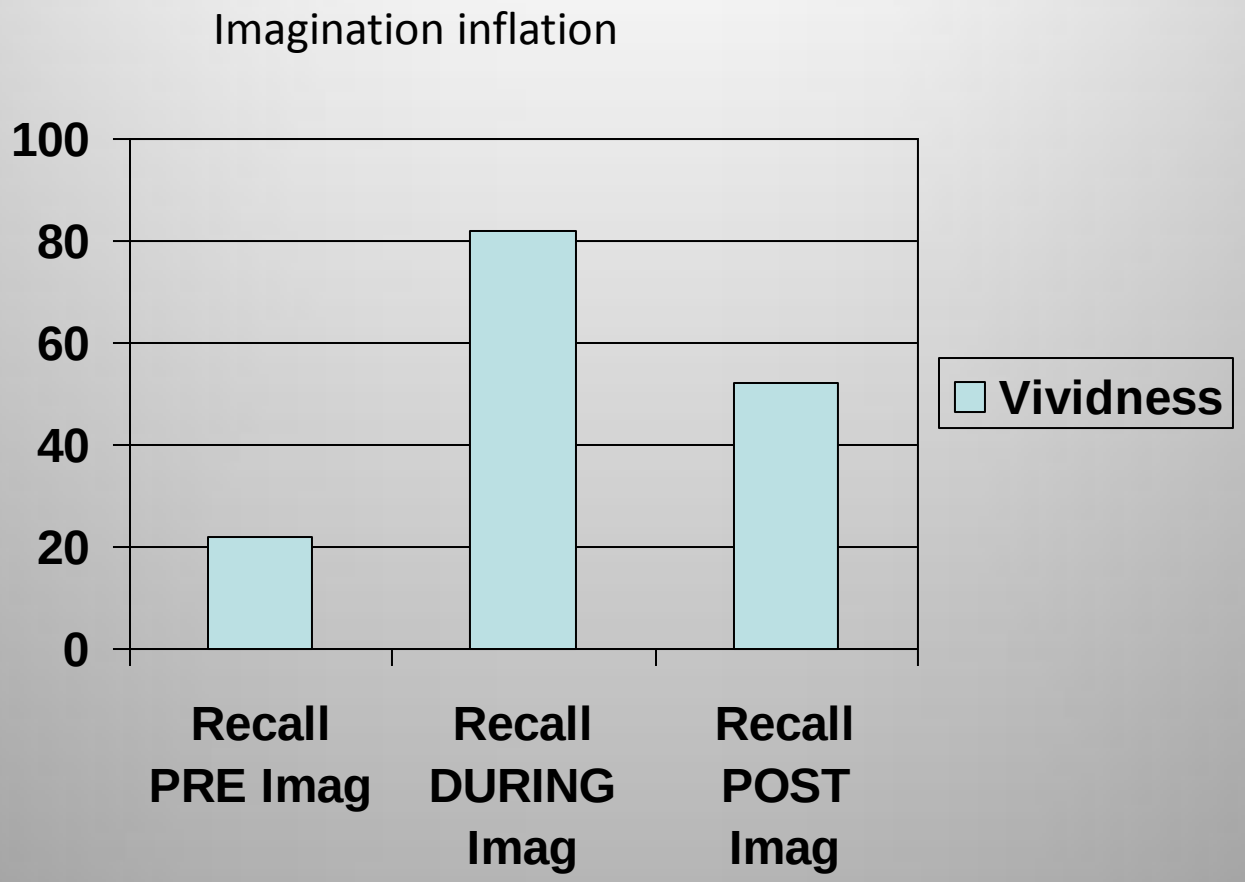
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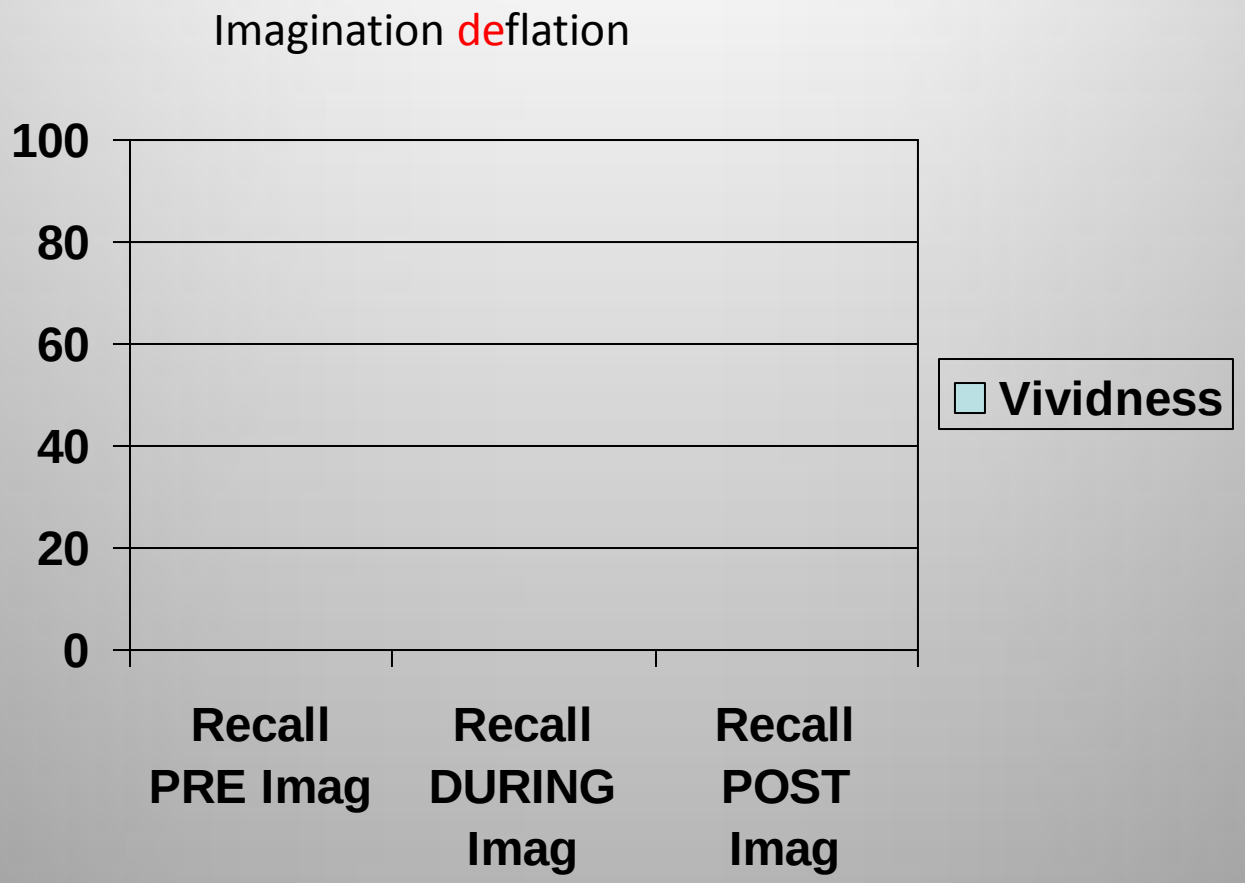
Recall DURING Imag
Recall POST Imag
Vividness

Computer memory vs. human memory

Plasticity of human memory: a) Memory *inflation*

b) Memory *deflation*


Imagination deflation
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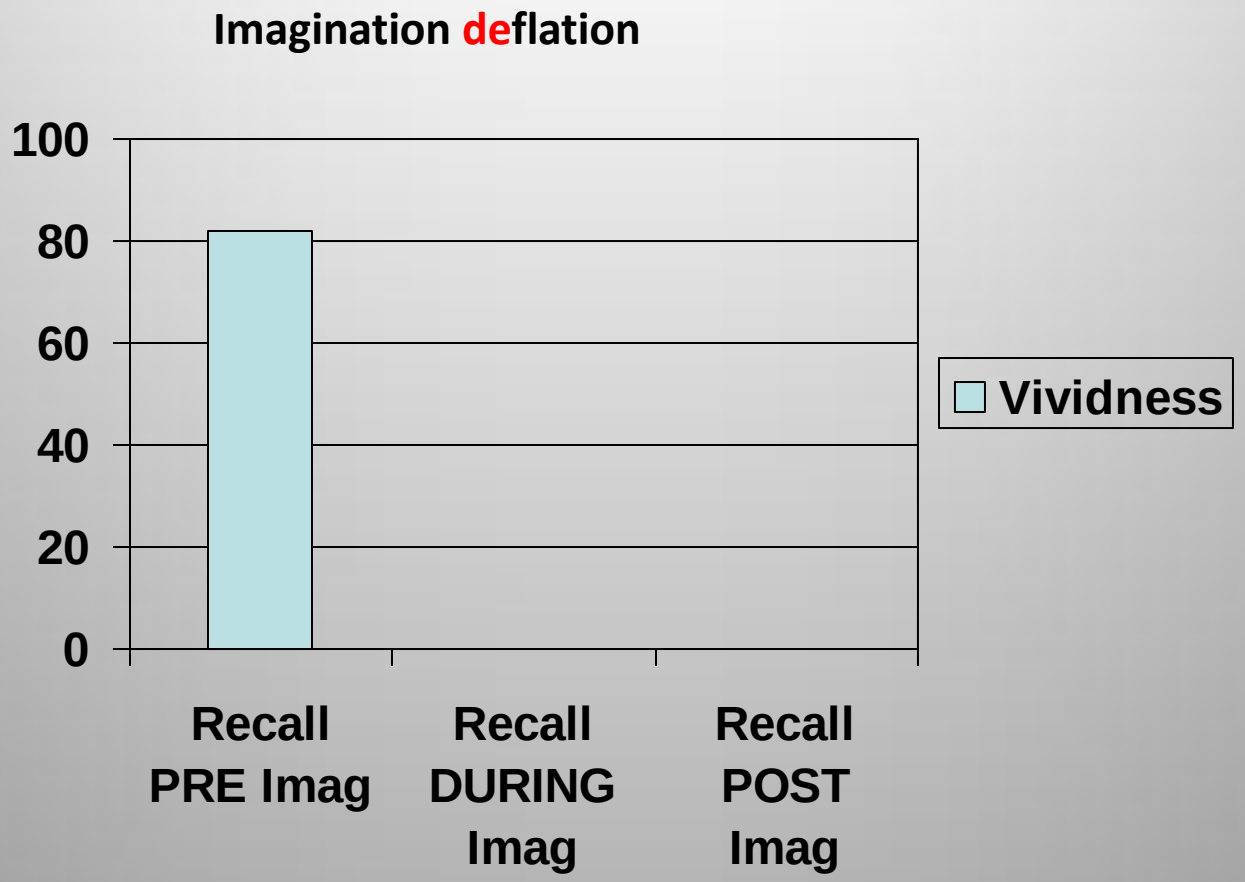
80
60
40
20
0
Recall PRE Imag
Recall DURING Imag
Recall POST Imag
Vividness


Imagination deflation
100
80
60
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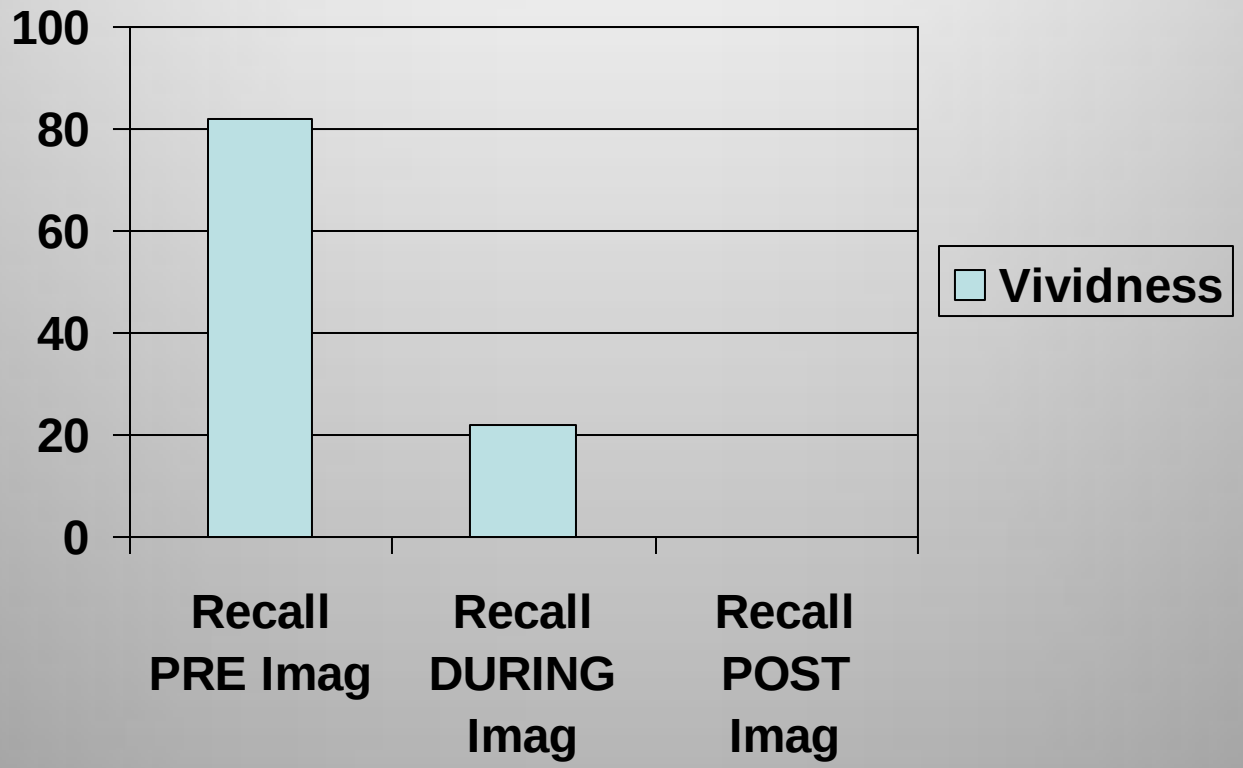
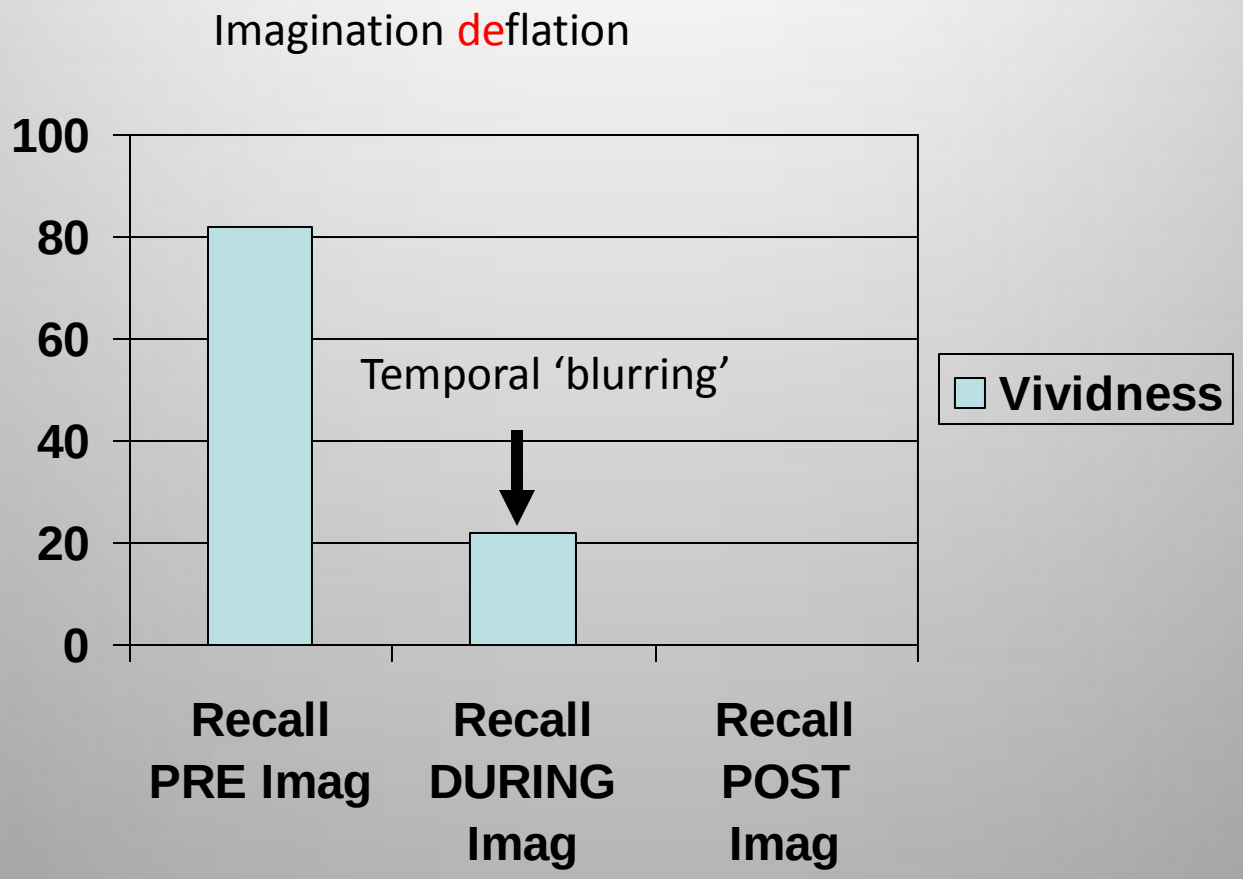
20
0
Recall PRE Imag
Recall DURING Imag
Recall POST Imag
Vividness

Imagination deflation




Imagination deflation
100
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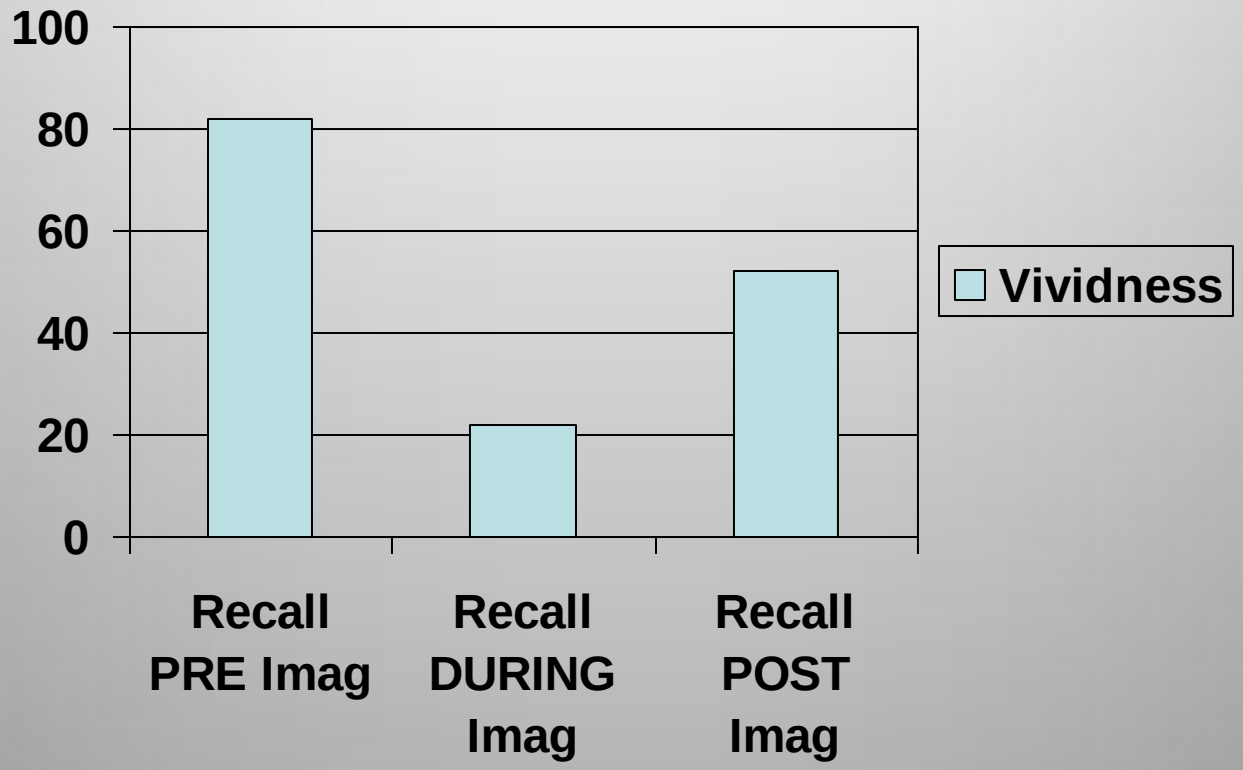
60
40
20
0
Temporal 'blurring'
Vividness
Recall PRE Imag
Recall DURING Imag
Recall POST Imag

Imagination deflation



Application to PTSD

Memory *inflation* in the *etiology* of PTSD:

Dutch troops after Iraq

Memory *deflation* in the *treatment* of PTSD:

the curious case of EMDR

1) Memory *inflation* in the *etiology* of PTSD:

Traumatic event → PTSD

- Duration; distance; number of combat events
- non-traumatic stressors (daily difficulties; e.g., King et al., 1995; Bolton et al., 2003)
- Often interpreted as "causal" impact
- But: retrospective reports (e.g., Schwarz, Kowalski, & McNally, 1993; Southwick et al., 1997)

→ Methodological limitations

Memory consistency study

Participants

- Infantry troops deployed in 2004

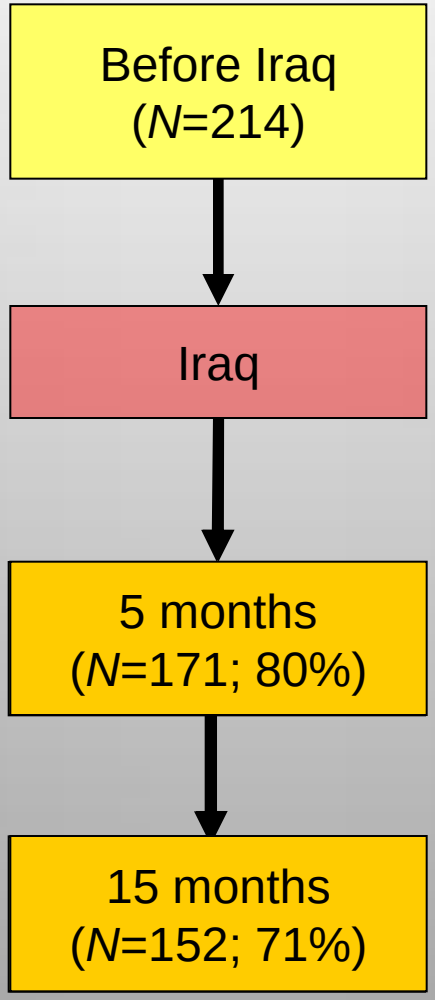
Measures

- PSS (Foa et al., 1993)
- 22 war zone stressors

30 non-traumatic stressors

→ Experienced? Impact? (1-4 scale) (Maguen et al., 2004)

(Engelhard, van den Hout, & McNally, 2008)

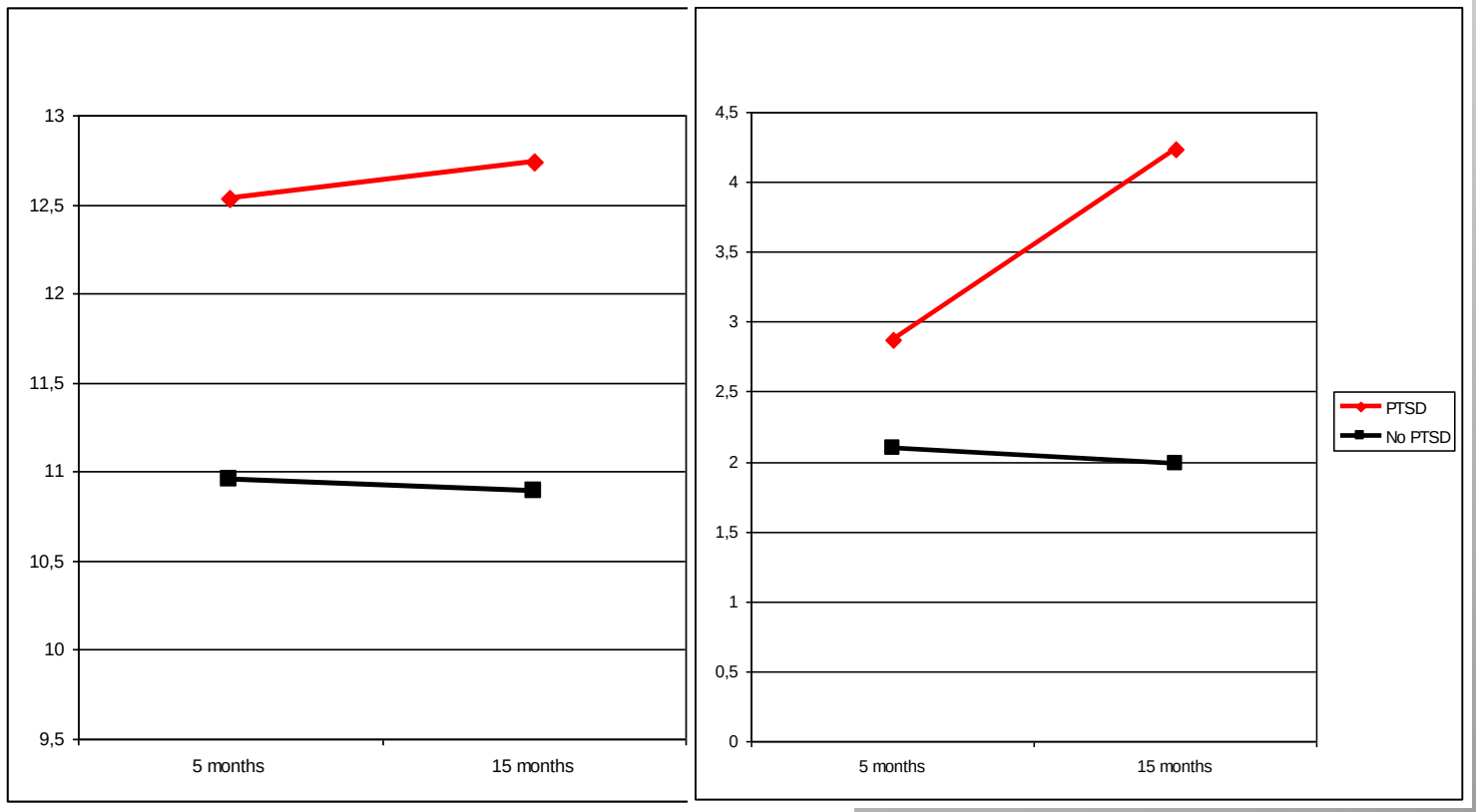

Before Iraq
(N=214)
Iraq
5 months
(N=171; 80%)
15 months
(N=152; 71%)

Traumatic stressor	Participants' responses					
	YY	YN	NY	NN	Change N	Change %
Injured civilians due to own action	16	29	20	68	49	37
Seeing dead/injured NATO (non-Dutch) soldiers	16	22	16	79	38	29
Seeing human remains	21	16	18	78	34	26
Seeing dead/injured civilians	48	7	25	53	32	24
Having to aid in removal of unexploded ordnance	10	16	16	91	32	24
Needing to manage civilians in chaotic conditions	74	13	16	30	29	22

Traumatic stressor	Participants' responses					
	YY	YN	NY	NN	Change N	Change %
Seeing dead/injured Dutch soldiers	52	13	13	55	26	20
Having to aid in removal of human remains	3	15	11	104	26	20
Being shot at	75	6	19	33	25	19
Locating unexploded land mines	12	9	15	97	24	18
Witnessing an explosion	90	14	9	20	23	17
Being injured because of an assault/attack	5	14	5	109	19	14

Fig 1: nr. of potentially traumatic stressors recalled

Fig 2: nr. of negative traumatic stressors recalled



(Engelhard, van den Hout, & McNally, 2008)

- Accounts of trauma are plastic over time
  - More severe current PTSD symptoms → increased reporting of (major and minor) stressor exposure

Memory *deflation* in the *treatment* of PTSD

The curious case of EMDR

Historical notes:

1) **EMDR: technique, theory and claims extraordinary and "extraordinary claims need exraordinary evidence"**

www.wildanimalsonline.com

Historical notes:

1) **EMDR: technique, theory and claims extraordinary and "extraordinary claims need exraordinary evidence"**

2) **Scientific community sceptical**

3) **EMDR outcome studies and meta-analyses: EMDR as effective as CBT**

Bradley et al. (2005).A multidimensional meta-analysis of psychotherapy for PTSD. *American Journal of Psychiatry, 162*, 214-227.

Seidler & Wagner (2006) Comparing the efficacy of EMDR and trauma focussed CBT in the treatment of PTSD. *Psychological Medicine, 36*, 1515-1522

Bisson and Ehlers, et al . (2007). Psychological treatments for chronic PTSD:A systematic review and meta-analysis. *British Journal of Psychiatry, 190*, 97-104.

Typical preparation of lab studies on EMDR

1) Healthy volunteers retrieve aversive memories

2) Pre-test: memories scored in terms of vividness/adversity

3) Interventions: during recall a) Recall + Eye movements
or
b) Recall only

4) Post test: recall and scored in terms of vividness/adversity

Three theories on EMDR effects considered here.

EMDR works

1) **Via exposure (recall only, EM's irrelevant)**

2) **By promoting "interhemispheric communication" during recall**

3) **Both EM's and recall need 'resources' of working memory.**
Recall 'looses competition" with EM's

Exposure Theories: Recall only = Recall + EM's (EM's irrelevant)

Januari 2011: at least 14 experiments

Author		Outcome	
		Recall Only	Recall + EM's
Adrade et al.,	(1997)	0	+
Van den Hout et al.,	(2001)	0	+
Kavanagh et al.,	(2001)	0	+
Kemps et al.,	(2007)	0	+
Maxfield et al.,	(2008)		
	Expt. 1	0	+
	Expt. 2	0	+
Gunter & Bodner	(2008)		
	Expt. 1	0	+
	Expt. 2	0	+
	Expt. 3	0	+
Lilley et al.	(2009)	0	+
Van den Hout et al.	(2010)	0	+
Engelhard et al.	(2010 a-b)	0	+
Hornsveld et al.	(2010)	0	+
Van den Hout et al.	(2011)	0	+
Van den Hout et al.	(2011)		
	Expt 1	0	+
	Expt 2	0	+
	Expt 3	0	+

Data:

Recall + EM's > Recall only

Therefore:

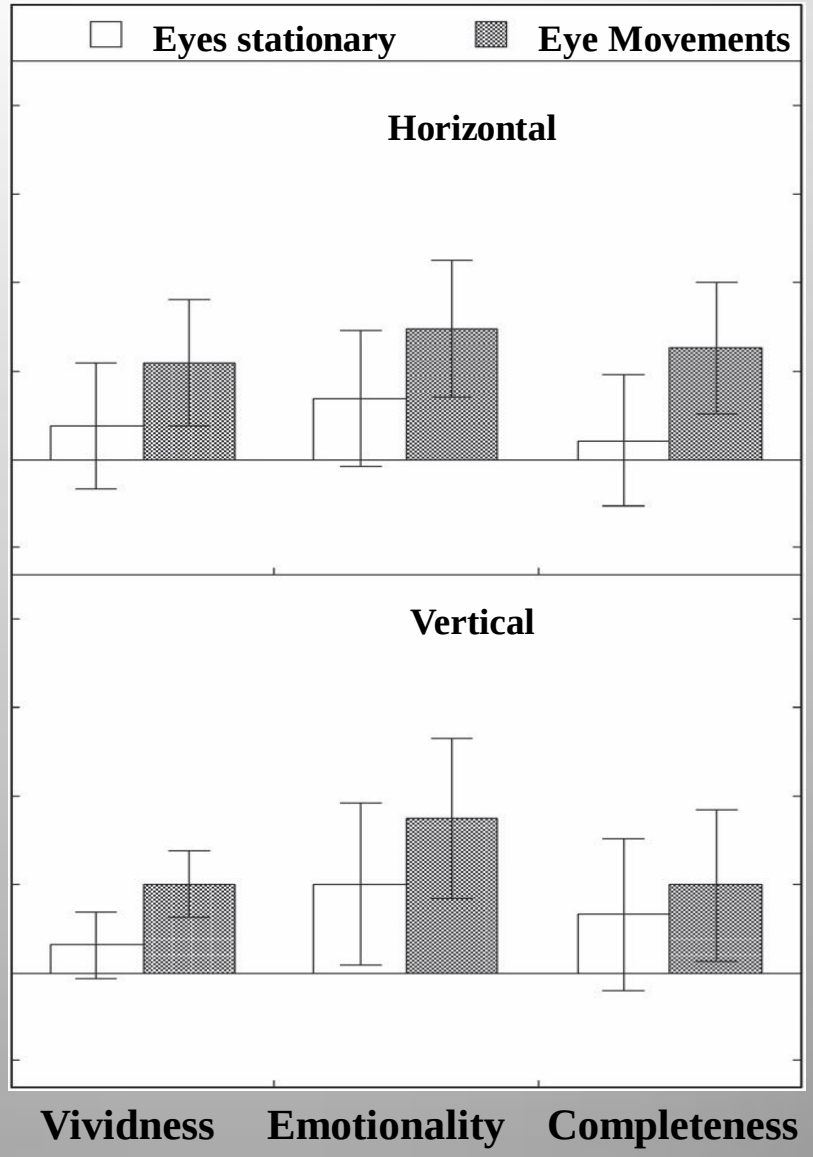
Exposure theories fail to explain EMDR effects

Interhemispheric communication theories

EMDR effects depend on Left-Right alternation of EM's.

Implication:
***Horizontal* EM's > *Vertical* EM's**

Pre-to-post decreases



From: Gunter & Bodner, 2008

Data:

Recall + horizontal EM's

=

Recall + vertical EM's.

Therefore:

"Interhemispheric communication" theory fails to explain EMDR effects.

Working Memory (WM) Theory: background.

1) WM: problem solving, planning, holding memory in mind etc.

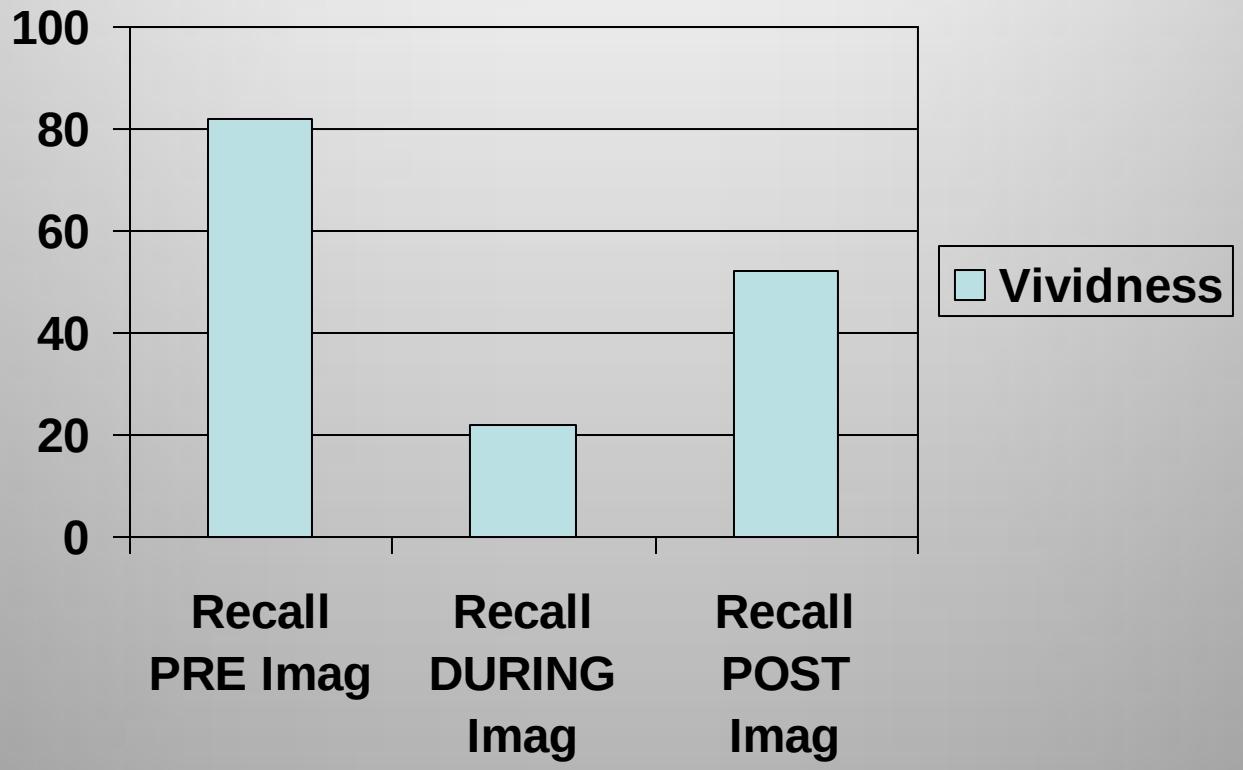
2) WM acts on 'limited resources'

3) EMDR: retrieval and EM's 'compete for WM resources': less resources available for retrieval

4) Therefore: *during* recall less vivid/less emotional and reconsolidated as less vivid

5) Reconsolidation of memory affected by recall.
Cf. Imagination inflation effect

Imagination deflation



Critical tests WM explanation of EMDR effects

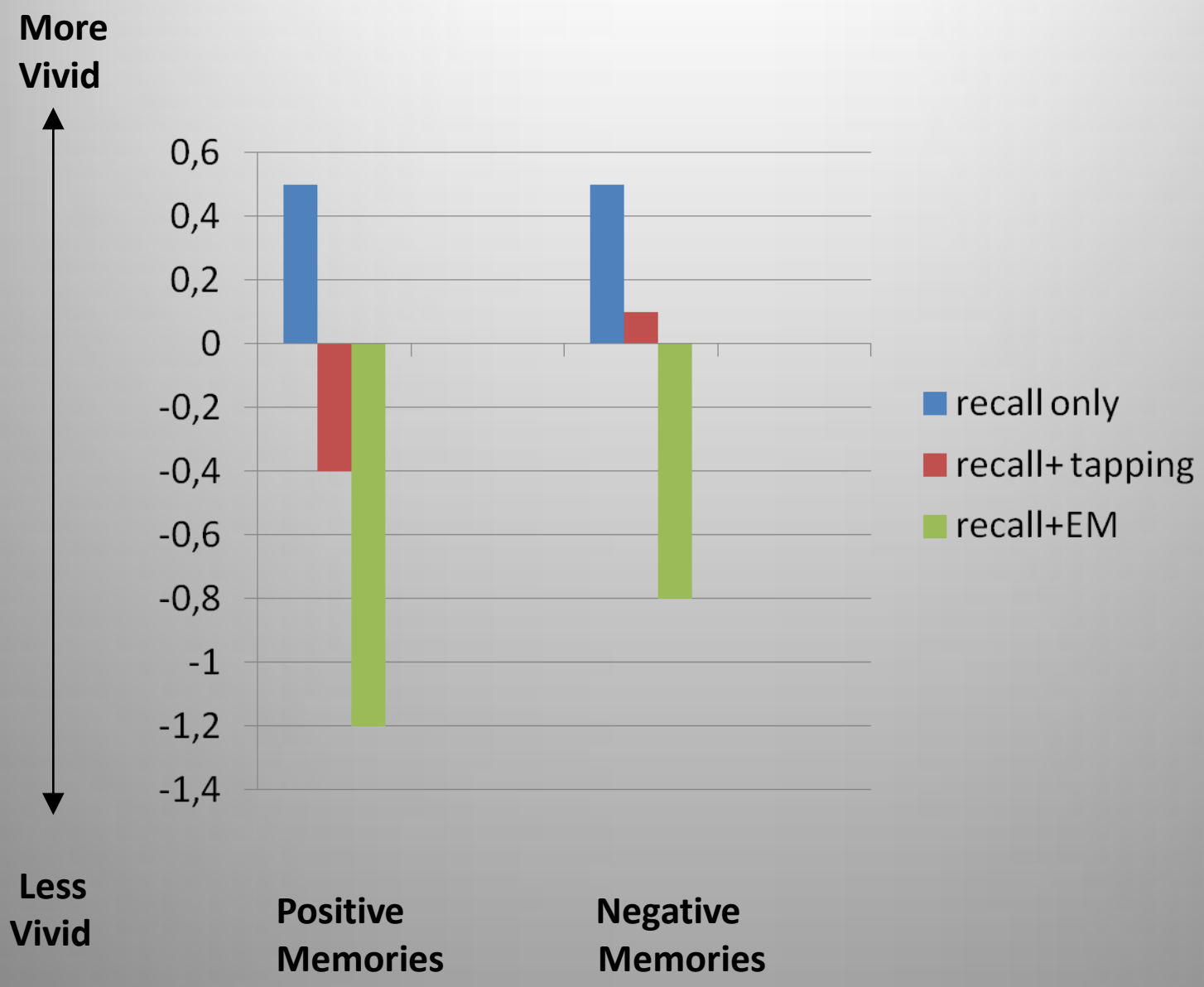
1) **Any technique that makes memory compete for WM resources→ reduction of emotionality**

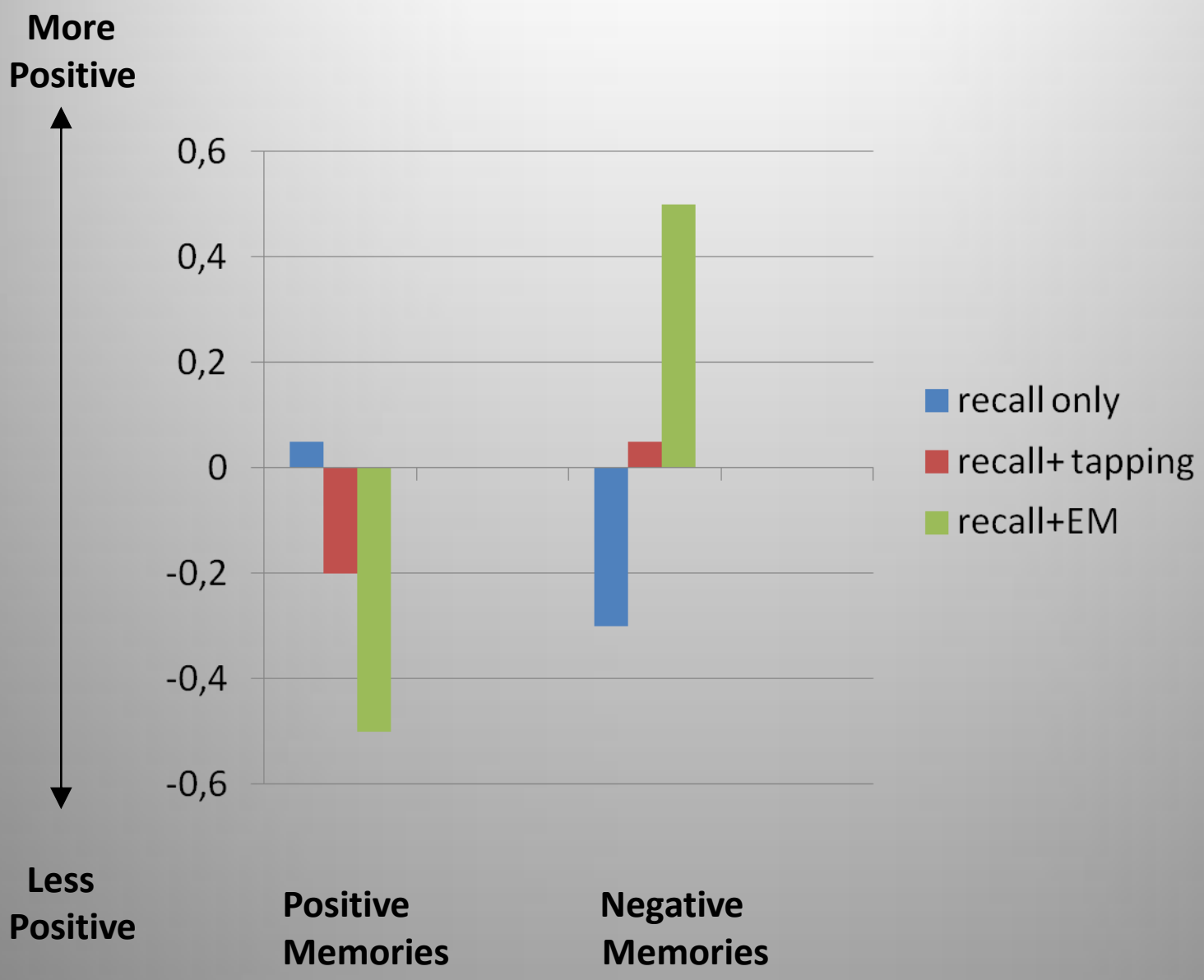
Technique	Author	Outcome	
		Recall only	Recall + WM taxing
1) Vertical EM's	(Gunter & Bodner, 2008)	0	+
2) Drawing	(idem)	0	+
3) Shadowing	(idem)	0	+
4) Tetris	(Engelhard et al, 2011)	0	+
5) Counting	(van den Hout et al., 2010)	0	+
	(Engelhard et al., 2010)	0	+
7) Articulatory suppresion	(Kemps et al., 2007)	0	+
8) Attentional breathing	(van den Hout et al., 2010)	0	+

Critical tests WM explanation of EMDR effects

1)Any technique that makes memory compete for WM resources→ reduction of emotionality

2) EM's during recall: Negative memories→ less negative.
Positive memories→ less positive.


More Vivid
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-0,8
-1
-1,2
-1,4
recall only
recall+ tapping
recall+EM
Less Vivid
Positive Memories
Negative Memories


More Positive
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
Less Positive
Positive Memories
Negative Memories
recall only
recall+ tapping
recall+EM

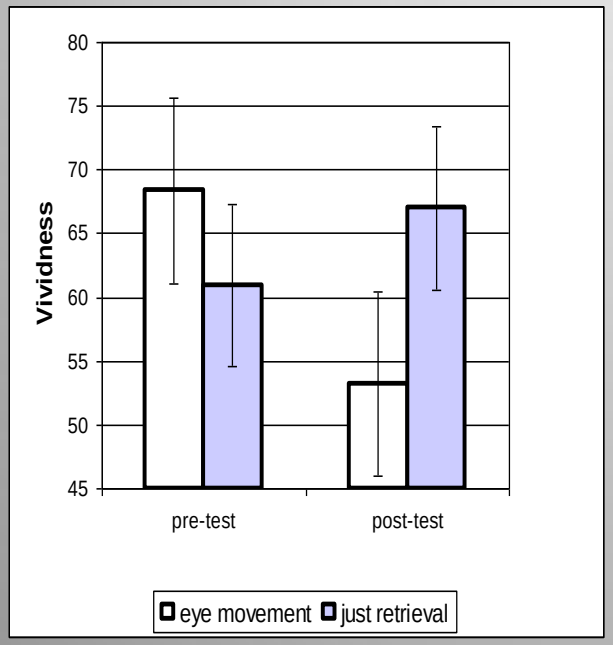
Critical tests WM explanation of EMDR effects

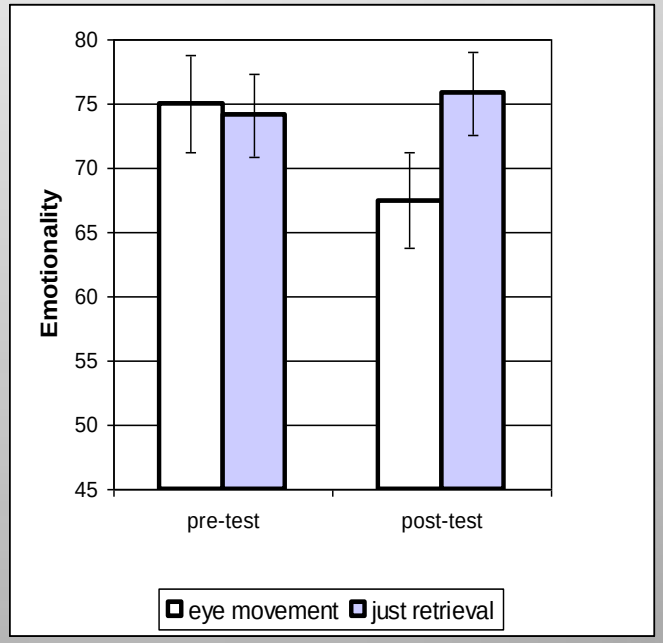
1) Any technique that makes memory compete for WM resources→ reduction of emotionality

2) EM's during recall: Neg. memories→ less neg.
Pos. Memories→ less pos.

3) Treatment of 'flash forwards' rather than "flash backs" should work *also*

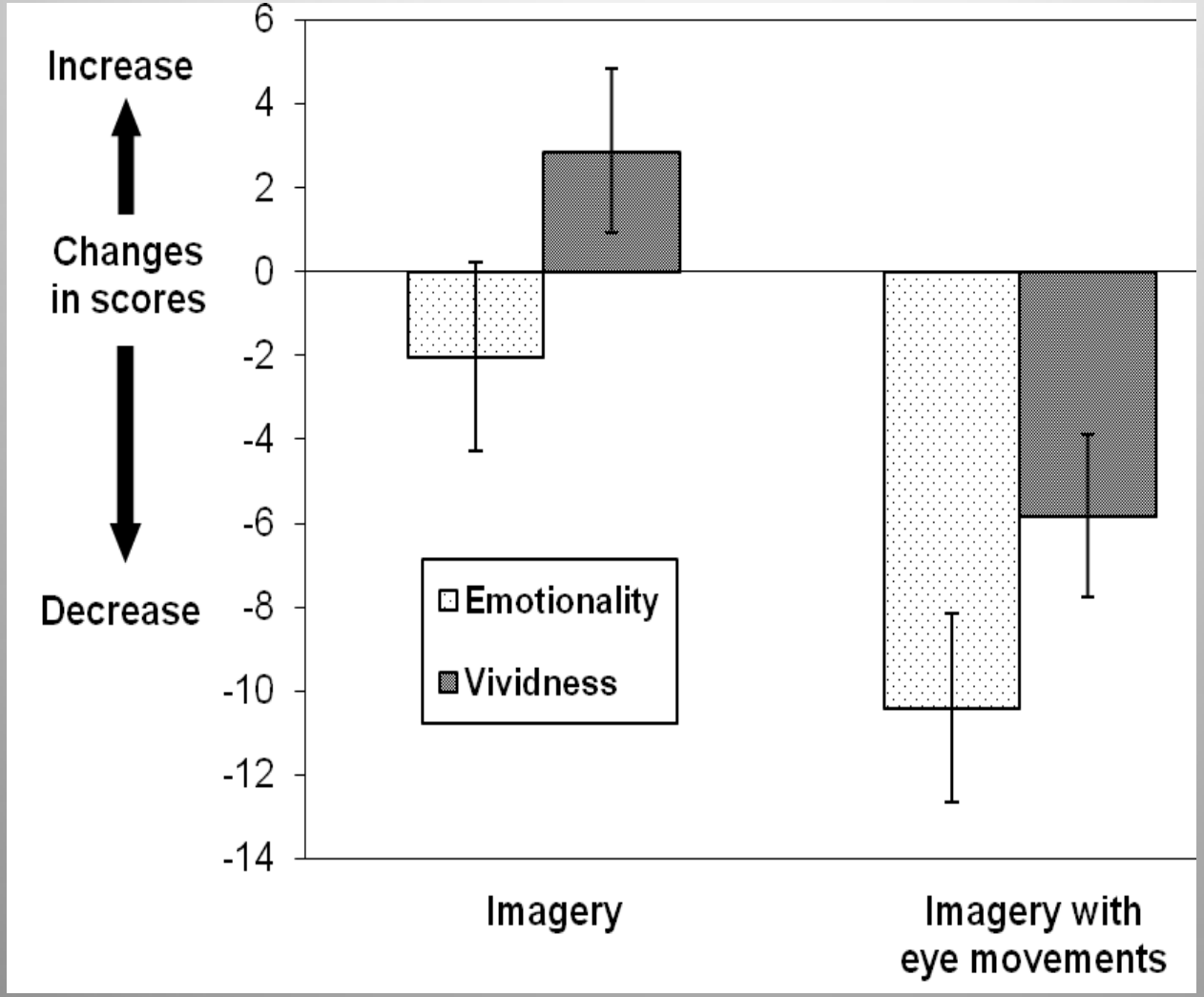
Change in “flash forwards” 1





Engelhard, van den Hout, Janssen & van der Beek, 2010 (Behav Res Ther)

Change in “flash forwards” 2



(Engelhard, van den Hout et al., 2011)

Critical tests WM explanation of EMDR effects

1) Any technique that makes memory compete for WM resources→ reduction of emotionality

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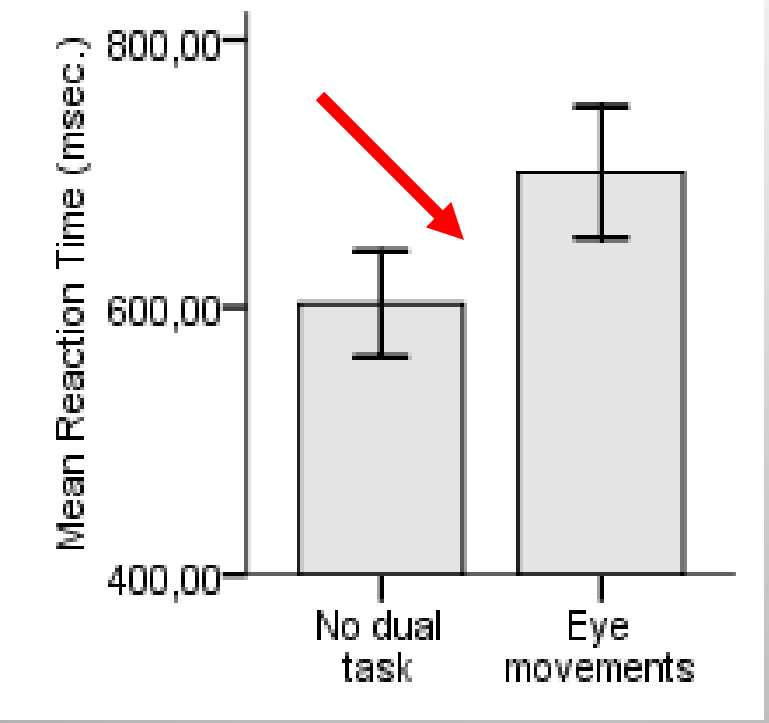
Pos. Memories→ less pos.

3) Treatment 'flash forwards' rather than flash backs

4) Effective treatments *really* tax WM



Van den Hout, Engelhard et al., 2011, Behav Res Ther,

Critical tests WM explanation of EMDR effects

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4) Effective treatments *really* tax WM

5) Bad at multi-tasking? Good effects EM's!

Correlations between WM span on prior test and reductions of vividness and emotionality during EM's etc.

	Vividness	Emotionality
(Gunter & Bodner, 2008)		
EM's	-0.44*	-0.43*
Shadowing	-0.69*	-0.59*
Drawing	-0.58*	-0.49*
Van den Hout et al., 2020, 2011 a)		
Counting	-0.31*	-0.18*
EM's	-0.30*	-0.29*
Attentional breathing	ns	ns
EM's (Positive background)	-	ns
EM's (Neutral background)	-	ns
EM's (Negative background)	-	ns
Engelhard et al, 2011		
EM's (Positive memories)	ns	-0.51*
EM's (Negative memories)	ns	-0.43*
Tetris	ns	ns

Critical tests WM explanation of EMDR effects

1) Any technique that makes memory compete for WM resources→ reduction of emotionality

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3) Treatment 'flash forwards' rather than flash backs

4) Effective treatments *really* tax WM

5) Bad at multi-tasking? Good effects EM's!

6) Dual task should not be TOO taxing (memory should be activated): inverted U predicted (Gunter & Bodner, 2008)

Inverted U?

Retrieval of memories about Queensday disaster (the Netherlands, 30 april 2009) under 4 conditions:

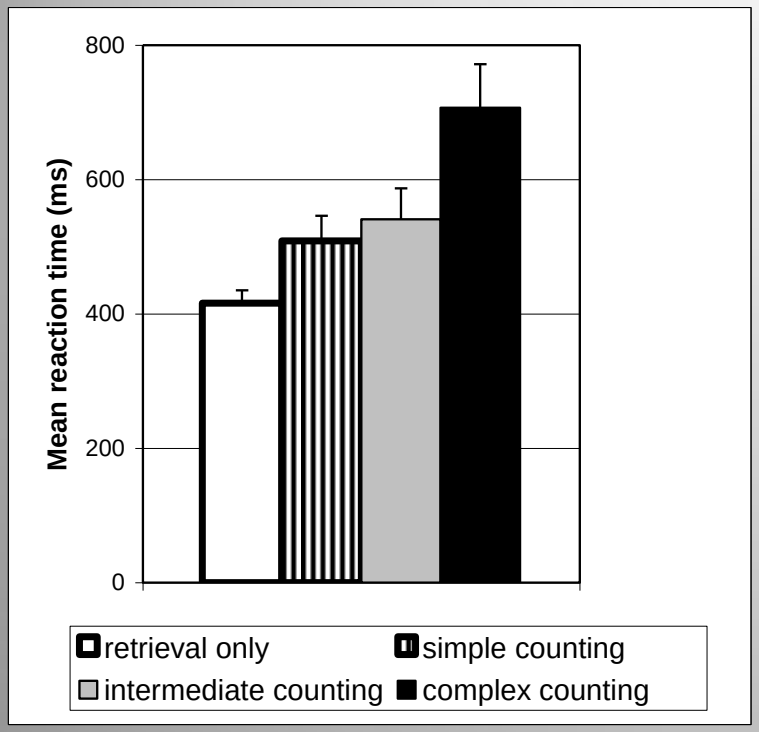
1) **no-dual task (exposure only)**

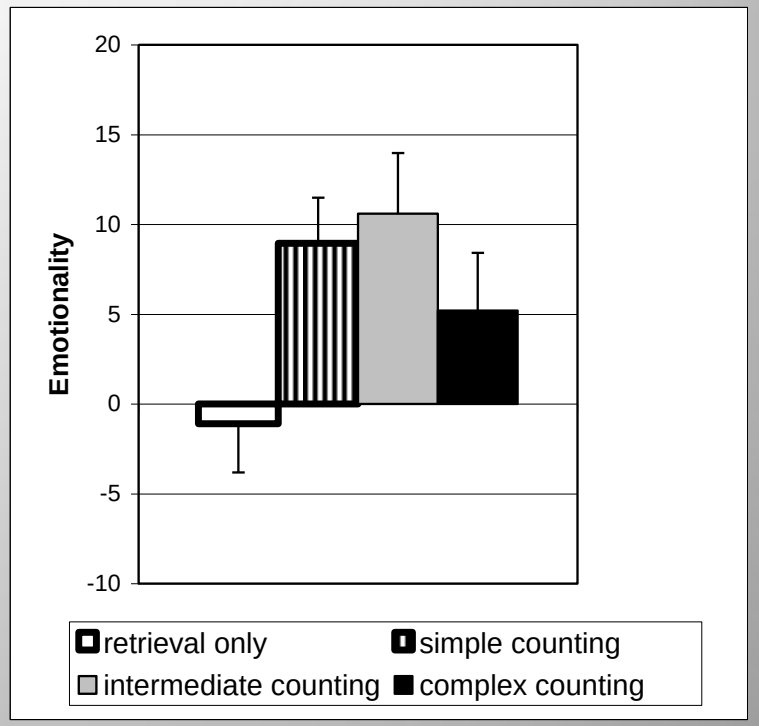
2) **Simple counting**

3) **Intermediate complex counting**

4) **Complex counting**

Engelhard, van den Hout & Smeets, J. Behav Ther. Expt Psychiat (2010)





Engelhard, van den Hout & Smeets, J. Behav Ther. Expt Psychiat (2010)

Support for WM explanation of EMDR:

1) Other WM taxing dual tasks effective (counting, drawing etc)

2) Positive memories after EM less positive

3) Flash forwards also affected

4) WM taxing is evident from RT tasks

5) Bad at multi-tasking→ Good response to EM, counting etc

6) Dose response relationship: inverted U

Clinical Issues

1) WM taxing during positive imagery/thoughts?

“Resource Development and Installation” (RDI) according to EMDR protocol

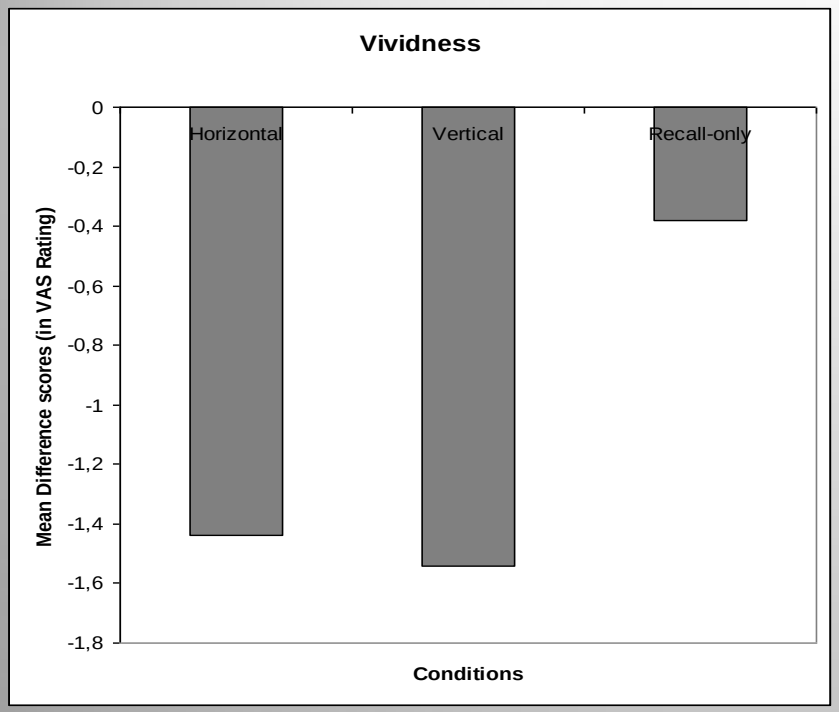
Activation of “positive, functional and resourceful memories” and simultaneous EM’s

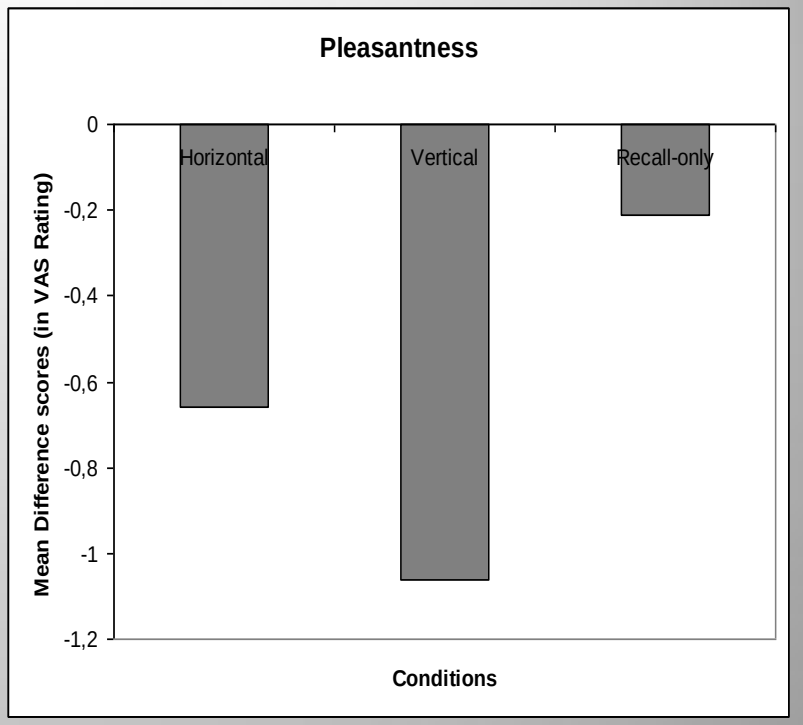
Experiment: RDI (positive memories!!) under three conditions:

a) Traditional (with *horizontal* EM’s)

b) Alternative (with *vertical* EM’s)

c) Crucial Alternative (*without* EM’s)





Hornsveld et al, 2011

Implication: WM taxing during positive ideation, counterproductive.

Clinical Issues (theoretically not irrelevant)

1) WM taxing during positive imagery/thoughts?

2) Memories for future events and treatment indication

Cf. earlier data:

EM's positive effects on vividness/emotionality of flash forwards

Implication: theoretical and empirical basis for treating “flash forwards”

Clinical Issues

1) WM taxing during positive imagery/thoughts?

2) Memories for future events and indication

3) Using beeps instead of EM's?

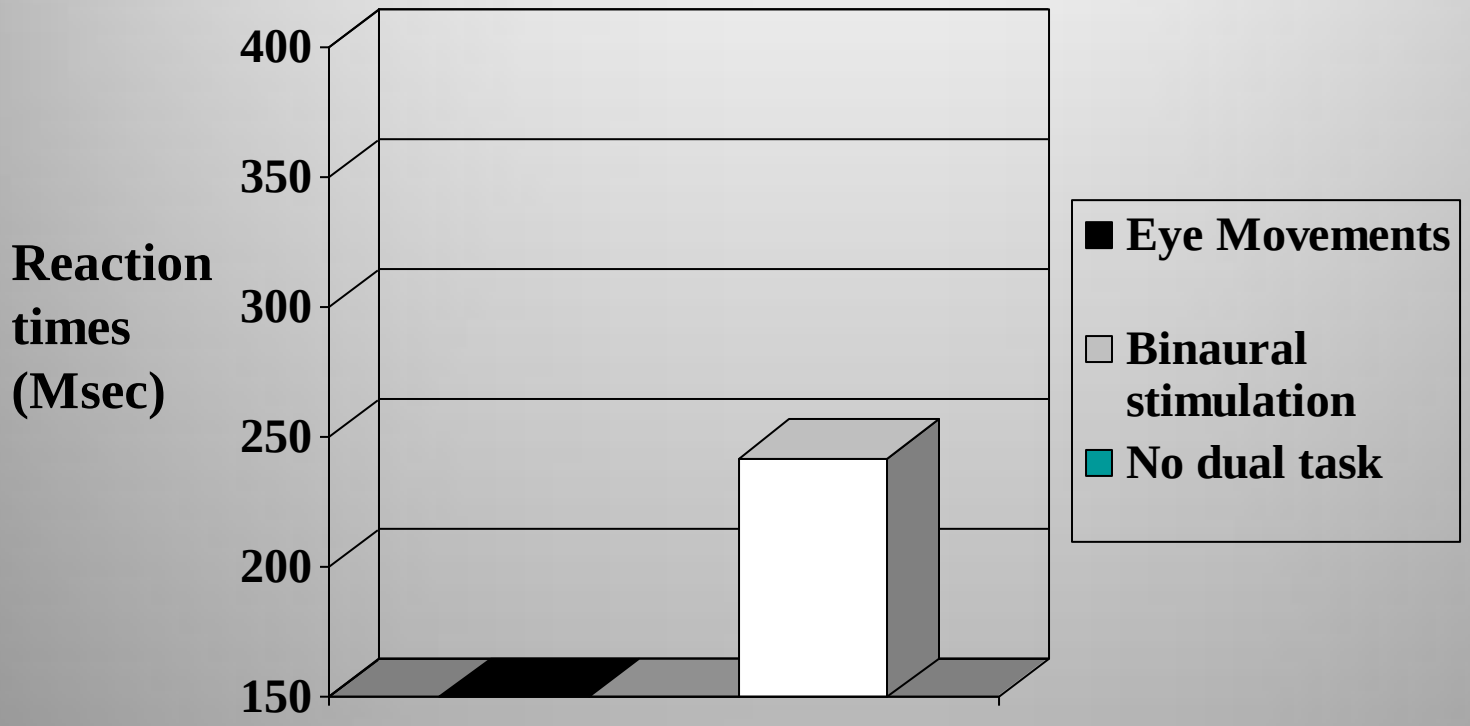
Replacing EM's by bilateral beeps

1) > 50% of actual EMDR sessions presently with beeps instead of EM's (Cf. interhemisphere theory of EMDR)

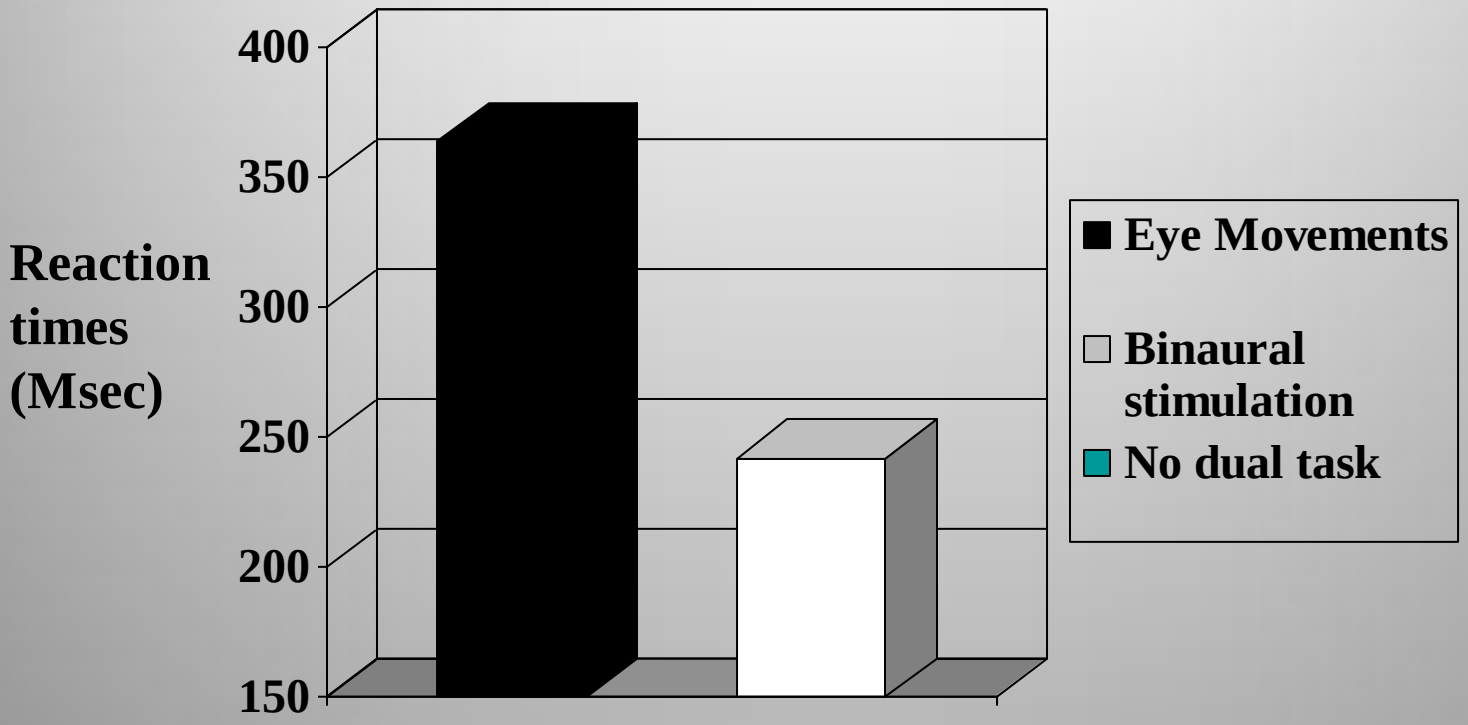
2) No studies on clinical effects of beeps

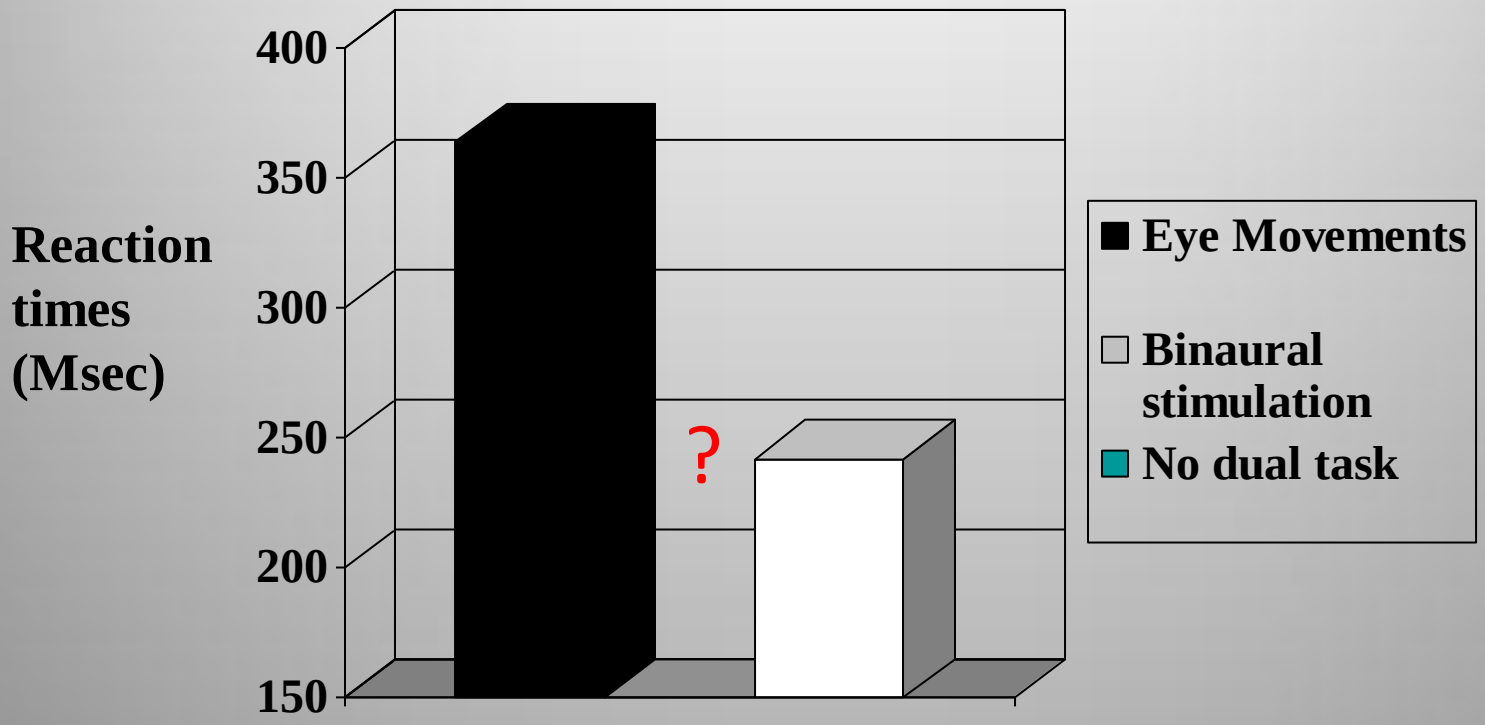
3) Do bilateral beeps tax WM?

4) Beeps effective in blurring memory?

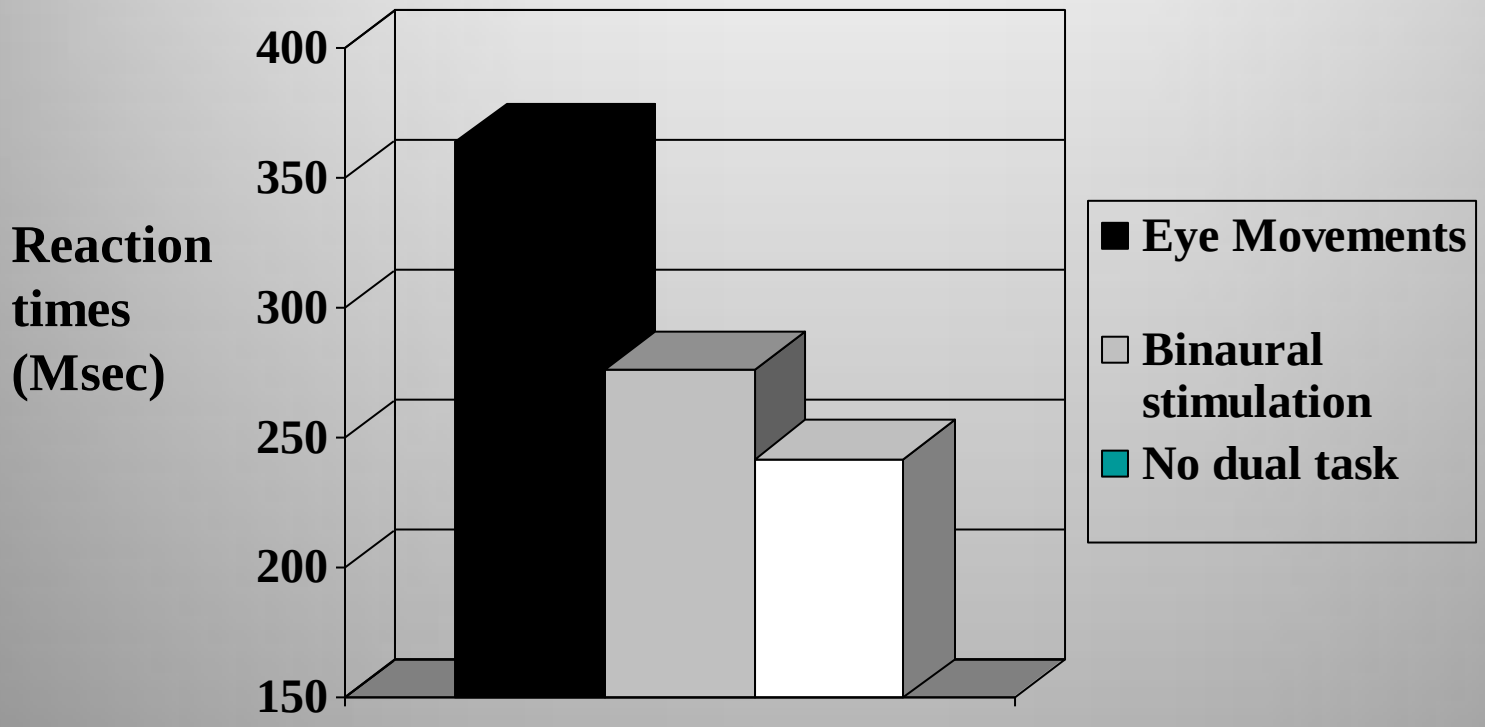


Van den Hout, Engelhard et al., 2011, Behav Res Ther.


Reaction times (Msec)
400
350
300
250
200
150
Eye Movements
Binaural stimulation
No dual task

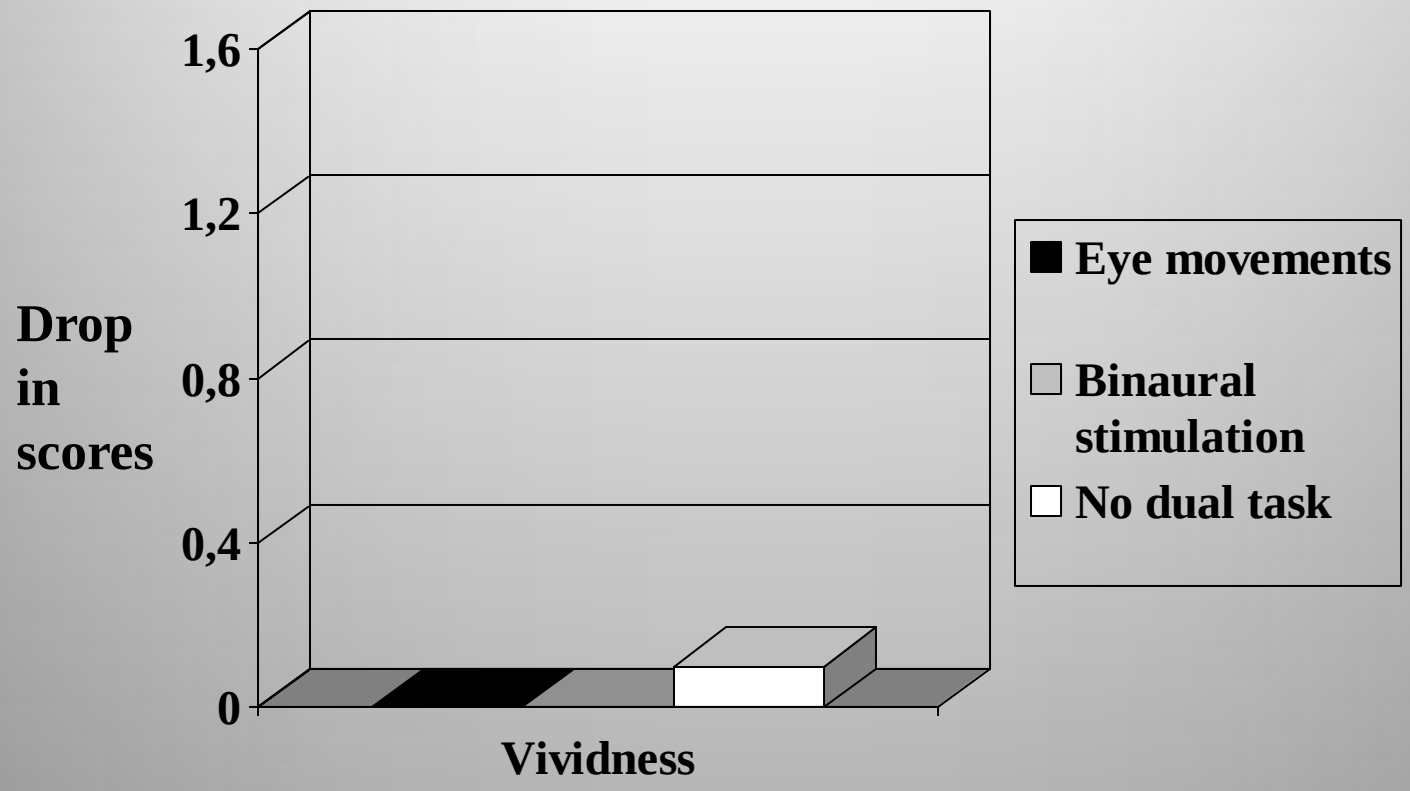


Van den Hout, Engelhard et al., 2011, Behav Res Ther.



Van den Hout, Engelhard et al., 2011, Behav Res Ther

Do beeps blur memory like EM's do?



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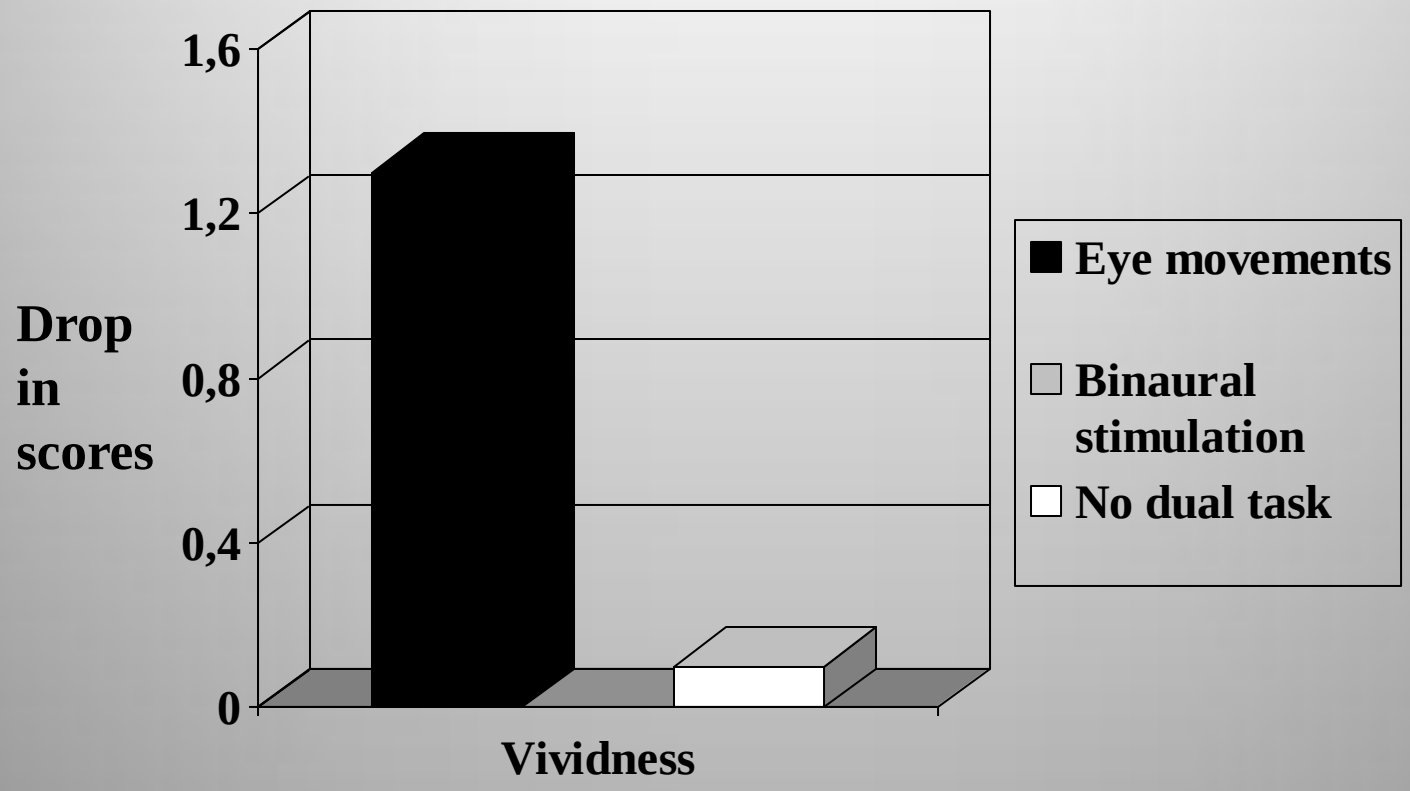
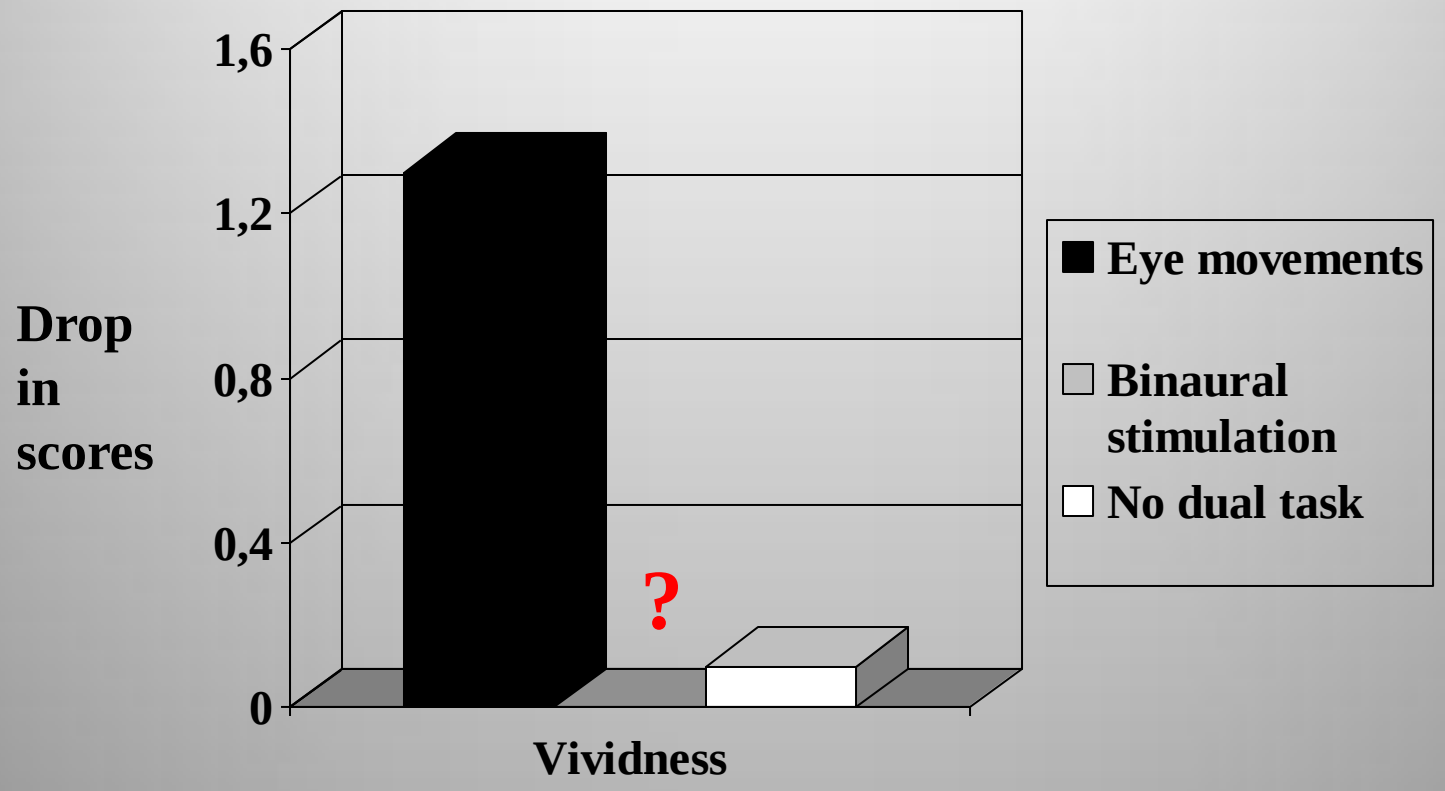
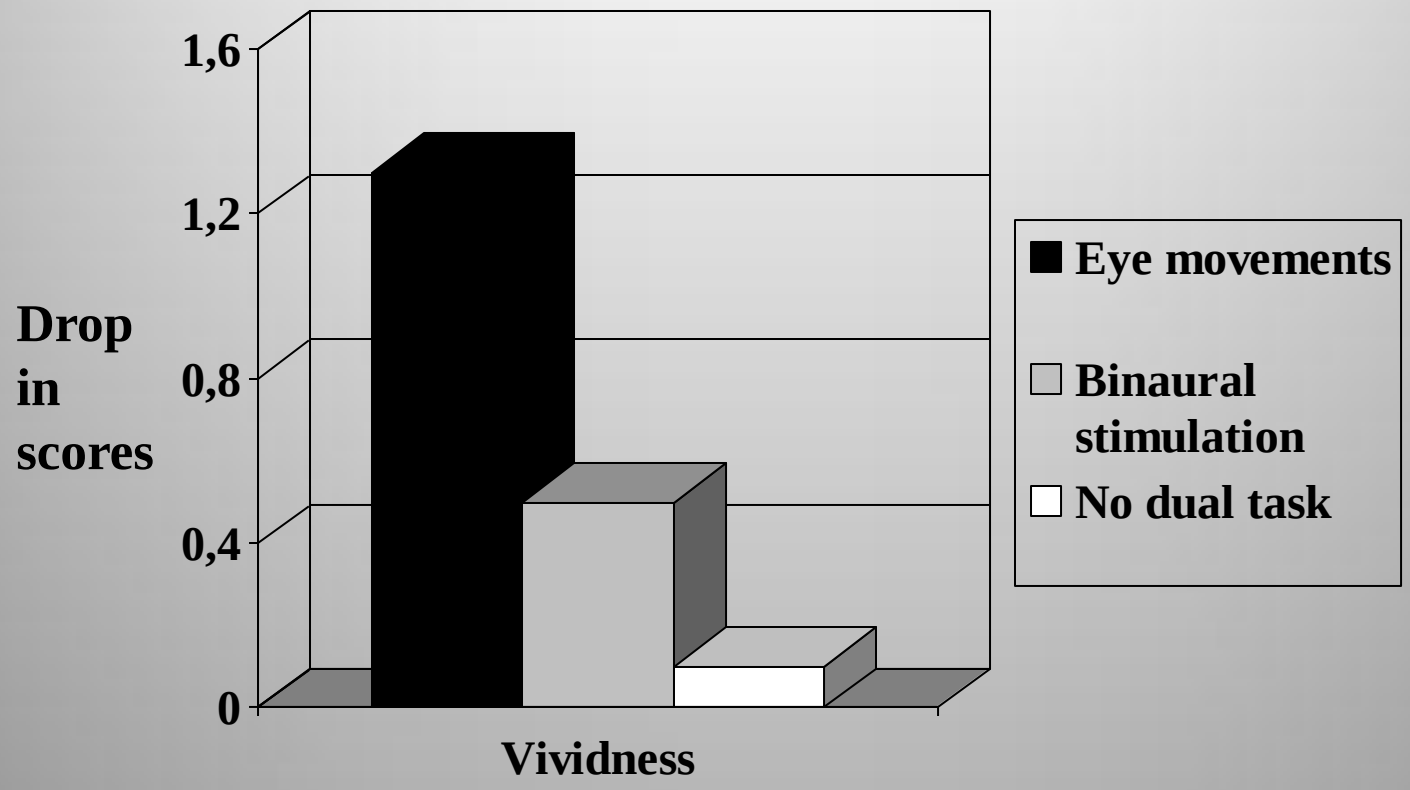


Van den Hout, Engelhard et al., 2011, Behav Res Ther.



Van den Hout, Engelhard et al., 2011, Behav Res Ther.



Van den Hout, Engelhard et al., 2011, Behav Res Ther.

Theory and data suggest:

Beeps inferior to EM’s

Objection: Experimental model ≠ clinical reality

1) Students had no PTSD

2) "Unpleasant memory" ≠ trauma

Question: How do *<u>real</u> PTSD* patients respond to beeps and EM's?

Clinical study; n= 12 PTSD

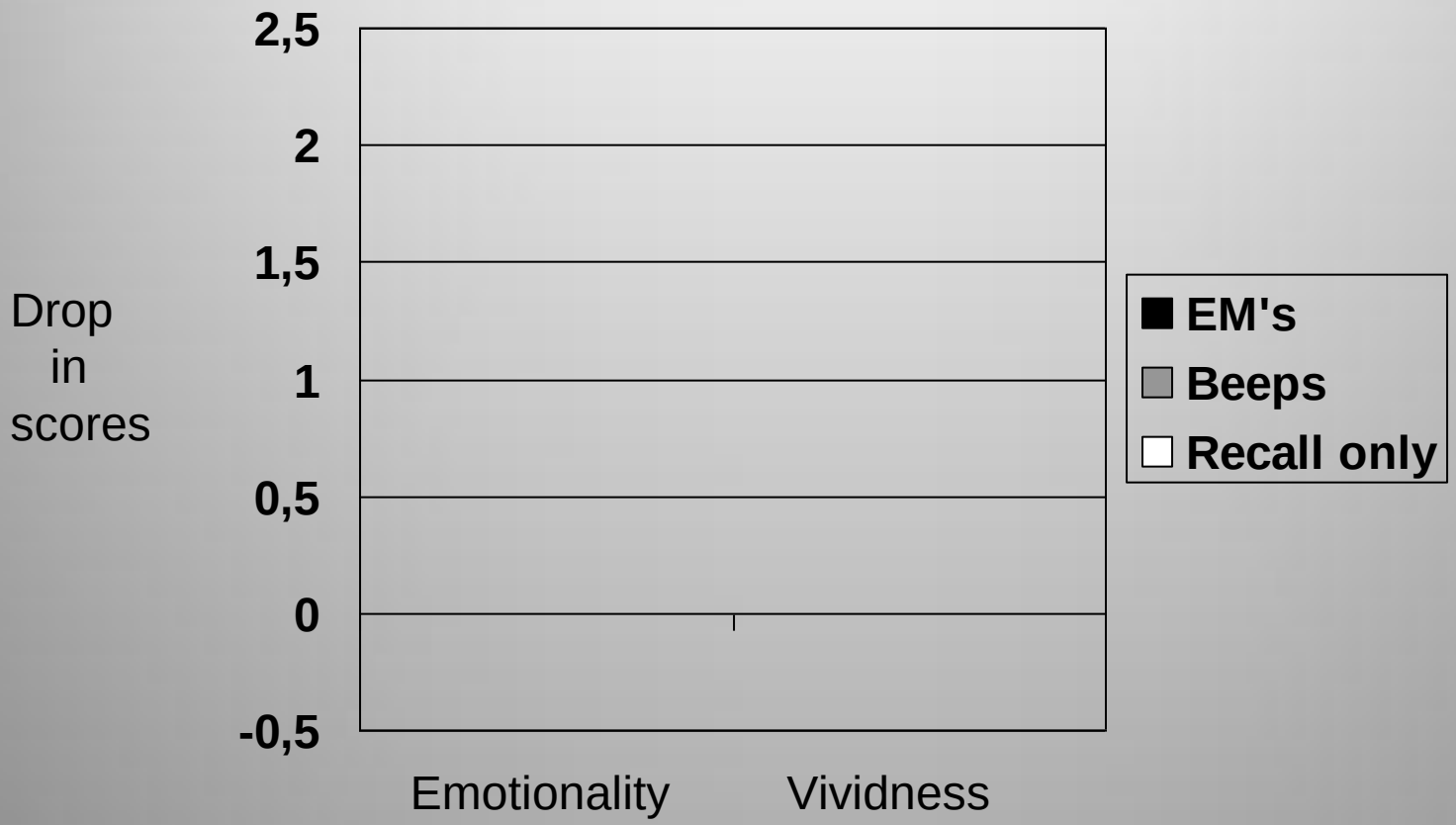
(van den Hout et al., 2012. Behav Res Ther)

(Rape (5 X), war + rape, years of sexual/physical abuse etc)

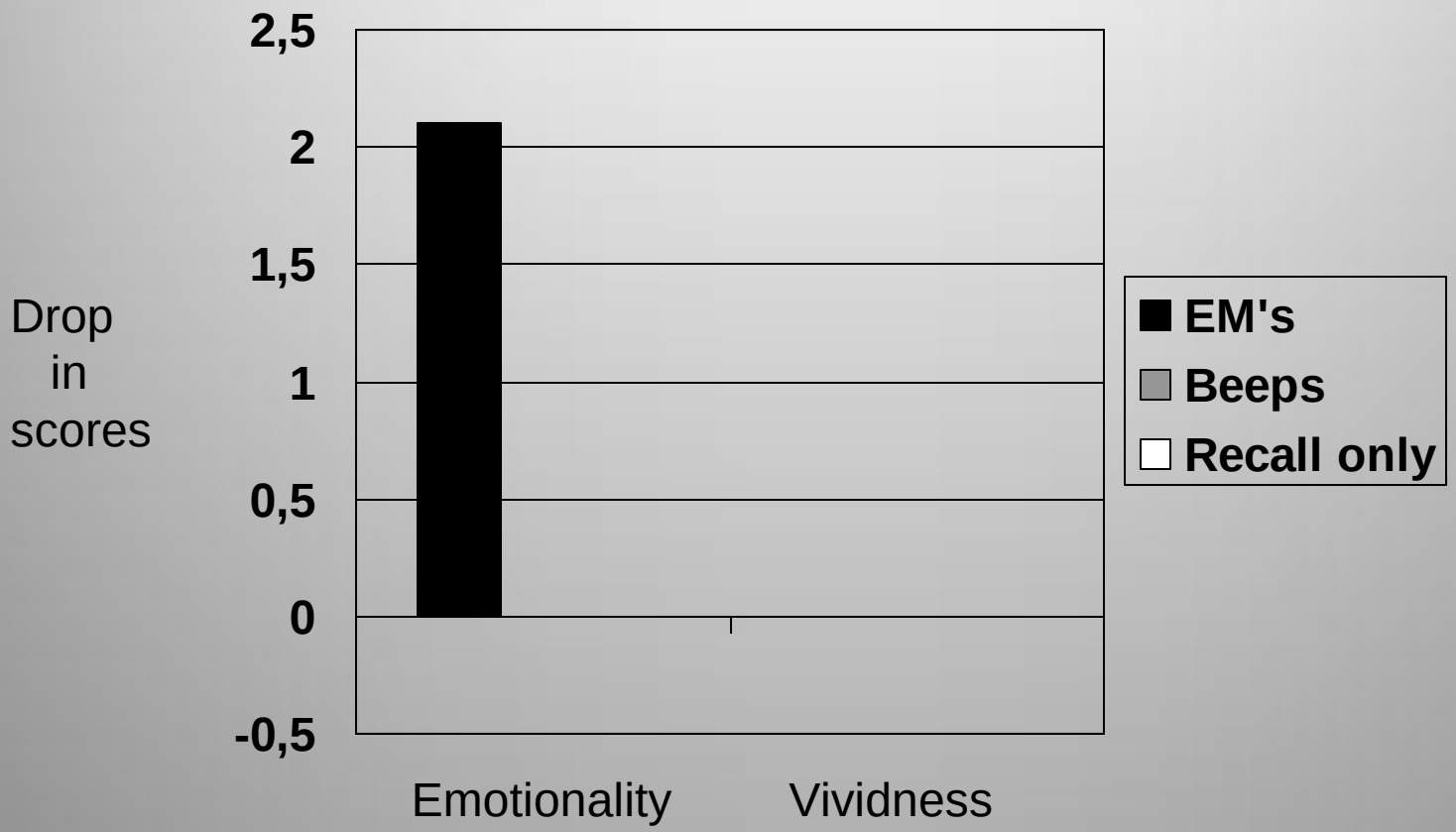
6 recalls during session 1: 2 X EM's
2 X Beeps
2 X Recall only

Order of interventions: Balanced

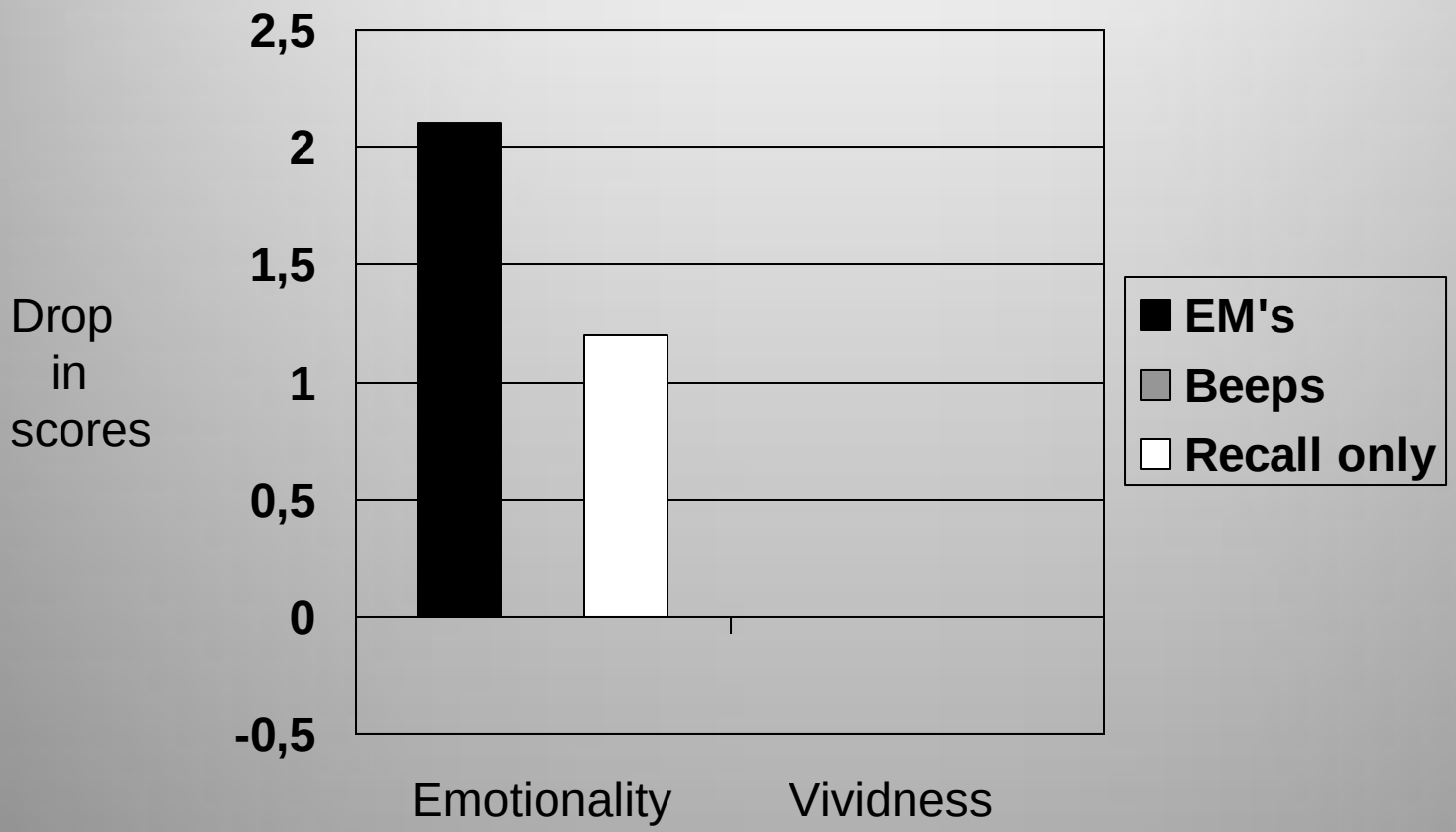
Dependant variables : Vividness
Emotionality (SUDS)



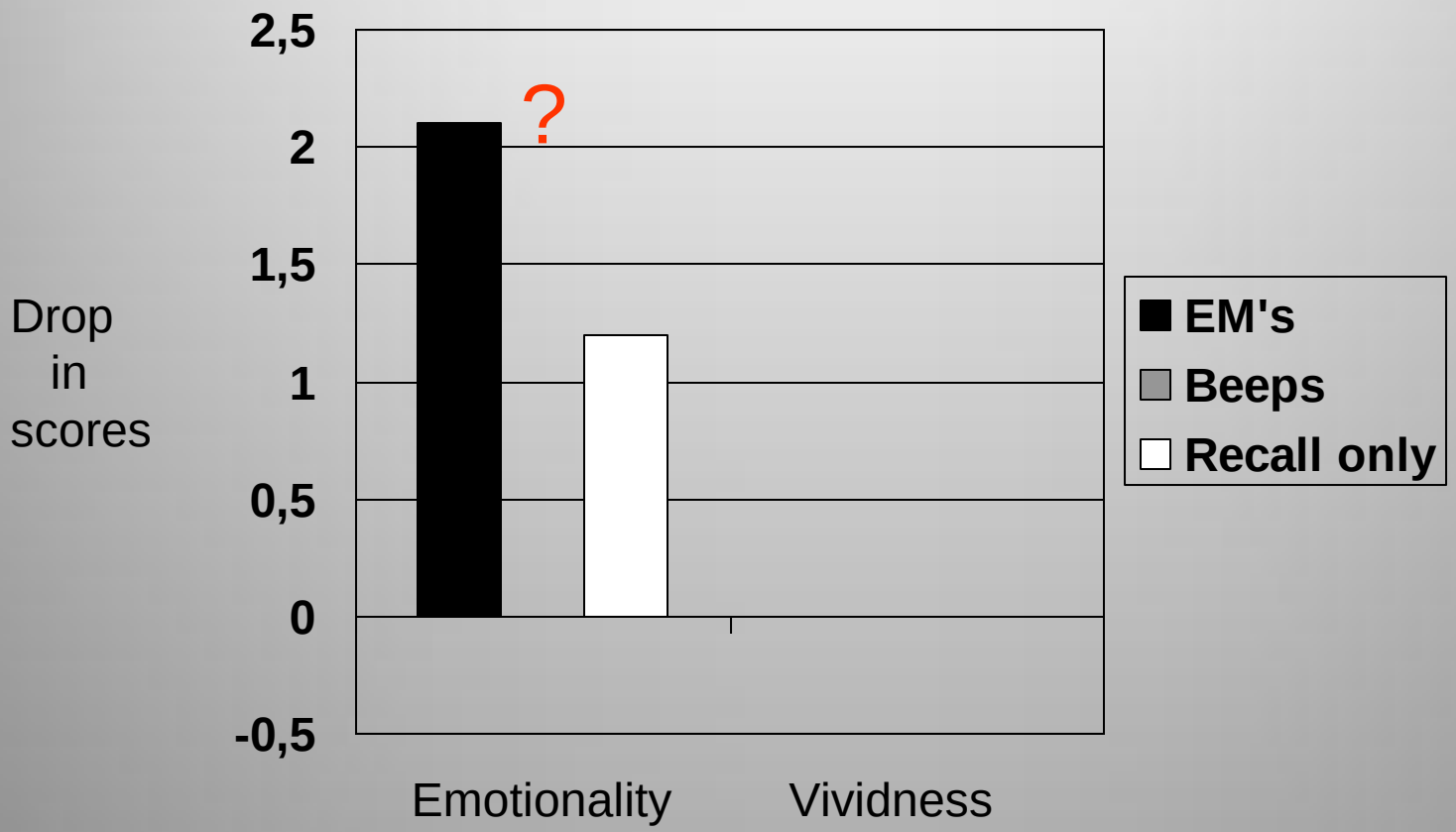
Van den Hout et al, Behav Res Ther, 2012



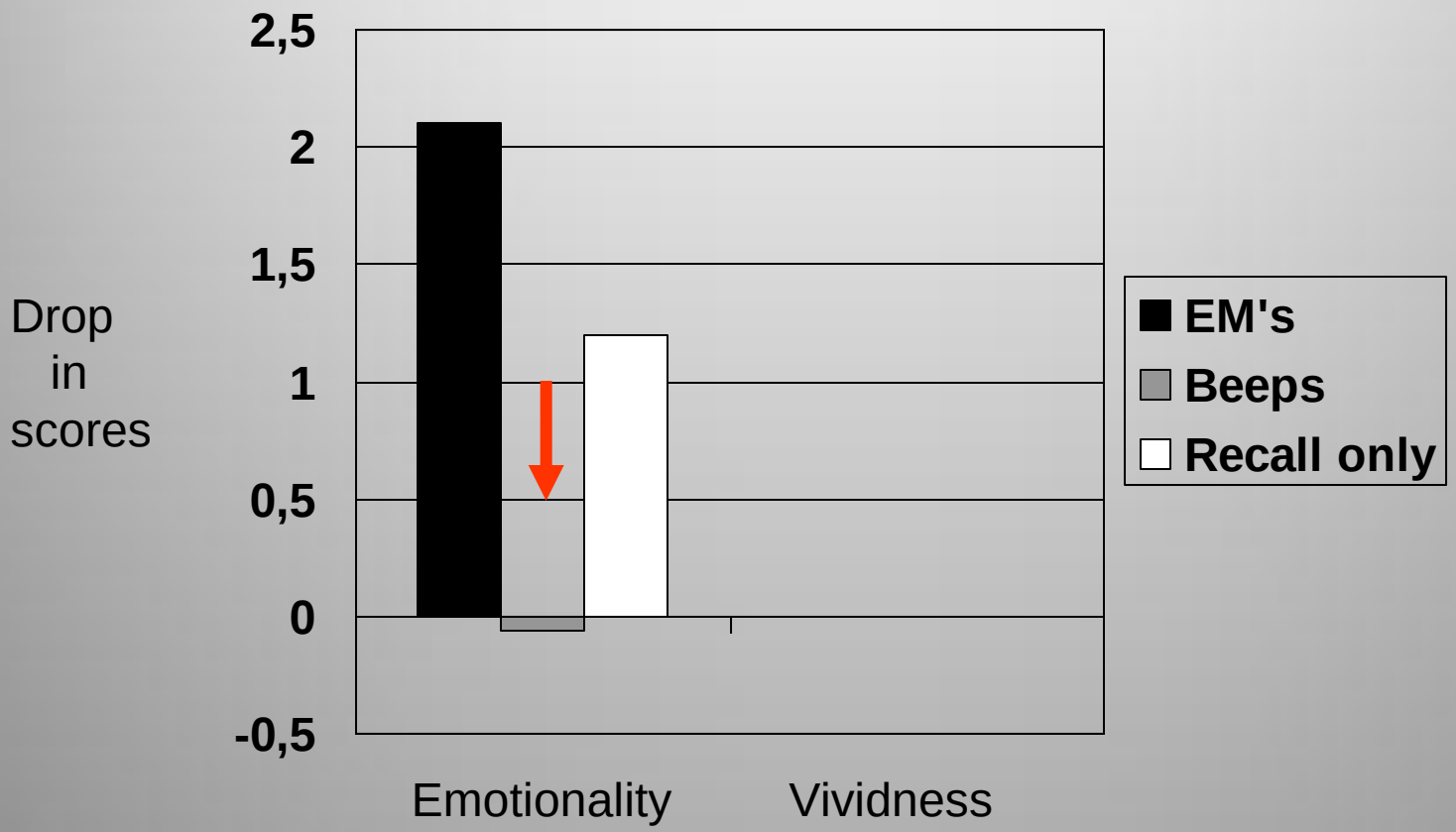
Van den Hout et al, Behav Res Ther, 2012



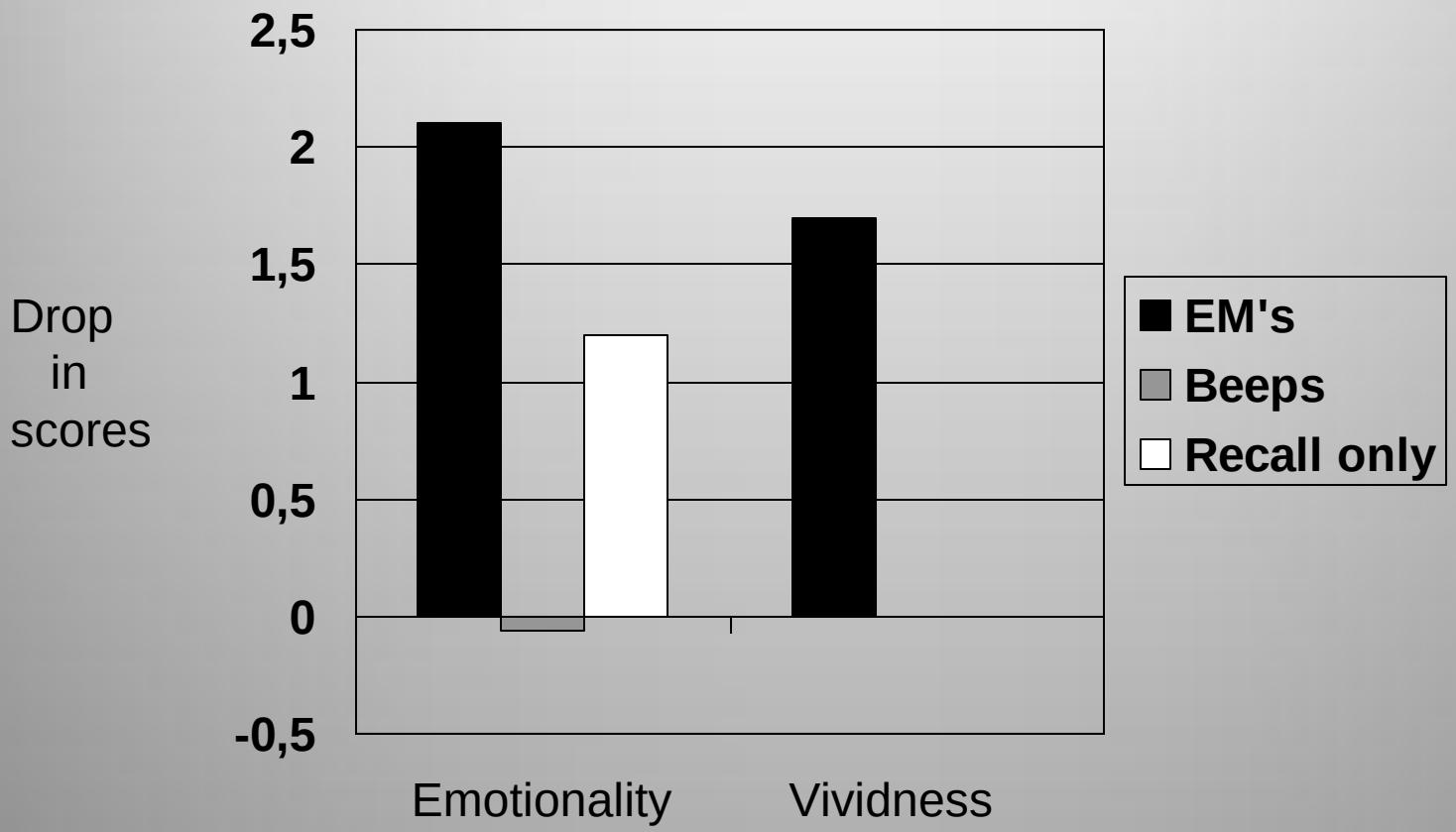
Van den Hout et al, Behav Res Ther, 2012



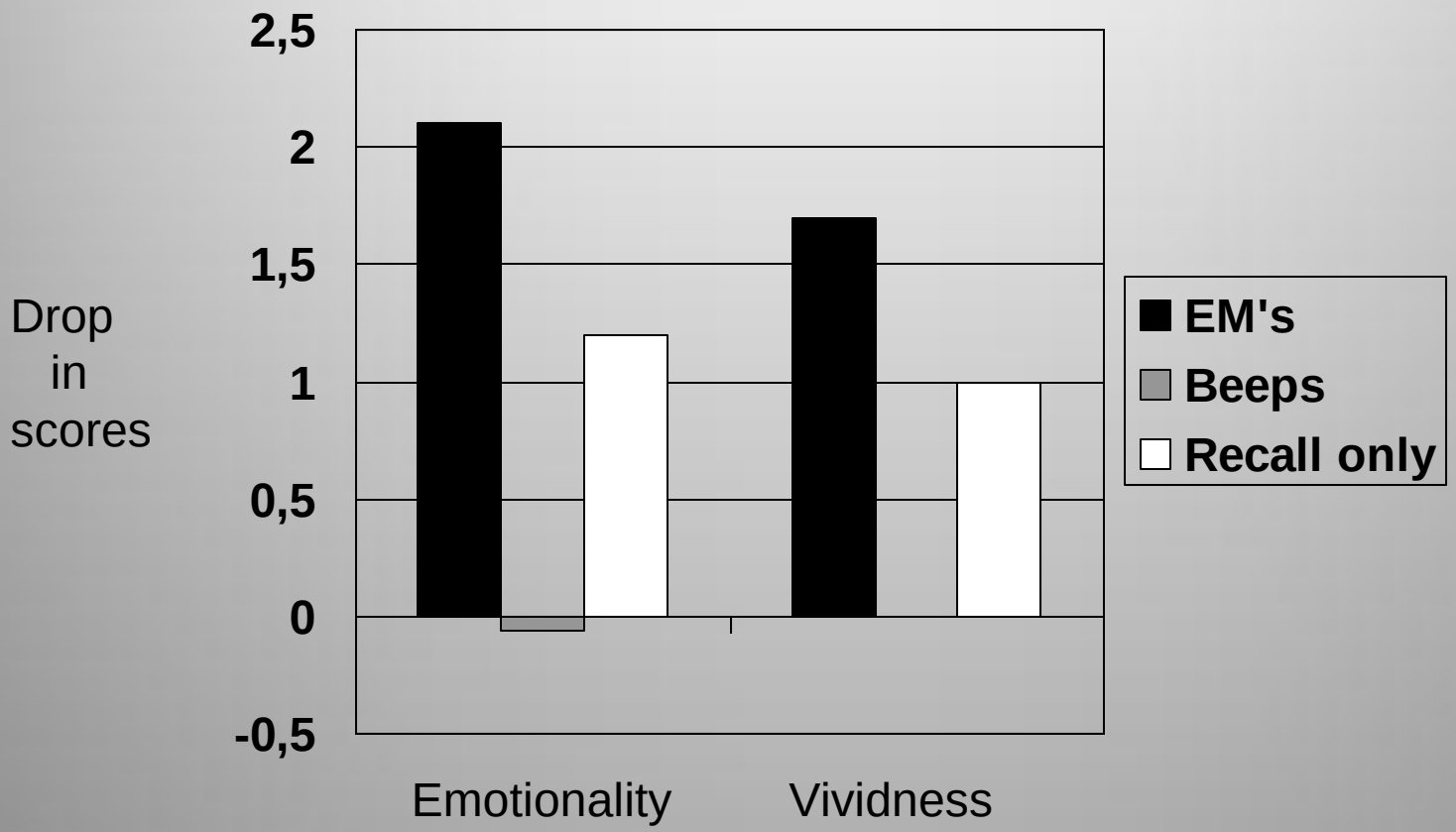
Van den Hout et al, Behav Res Ther, 2012

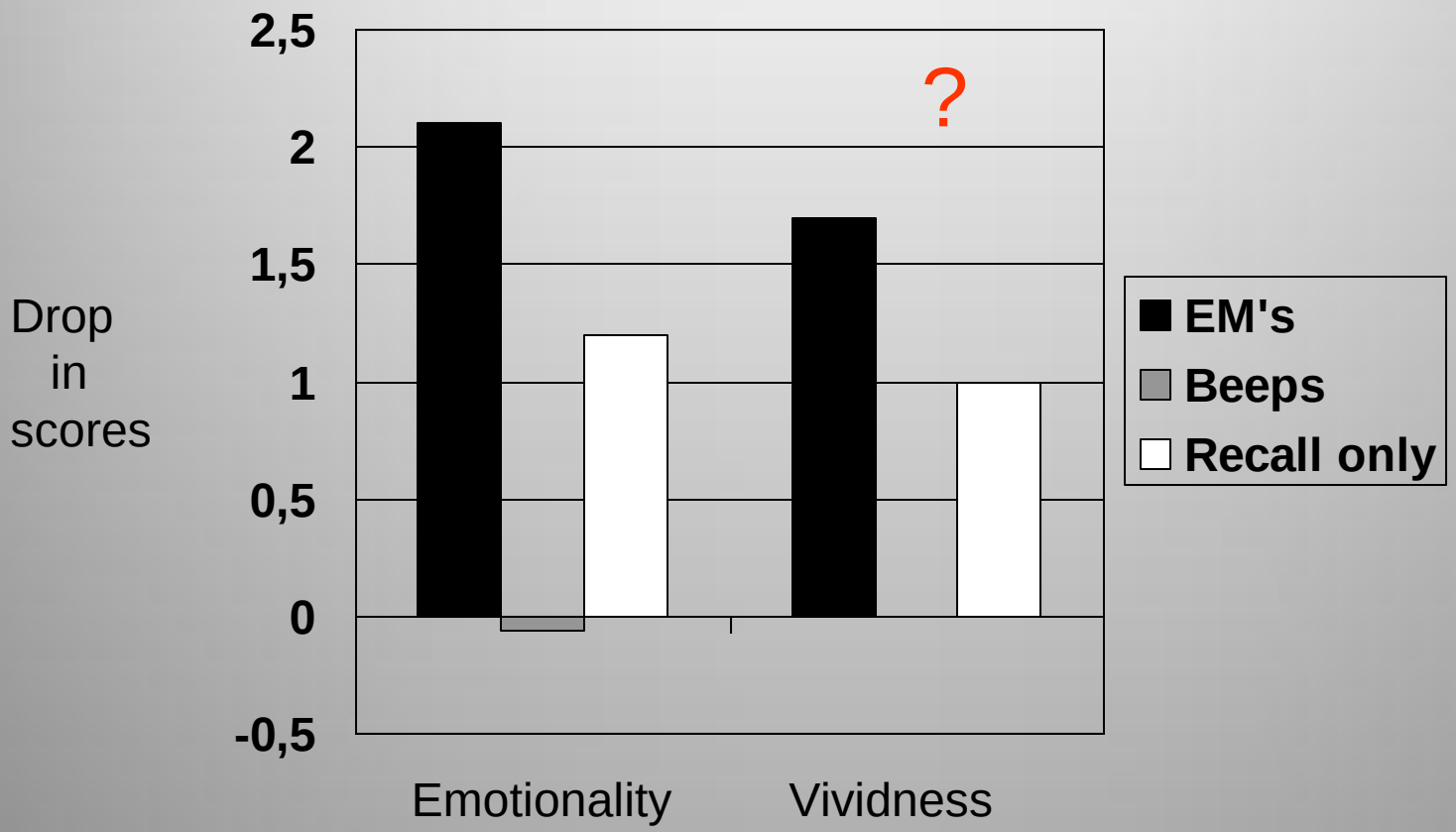


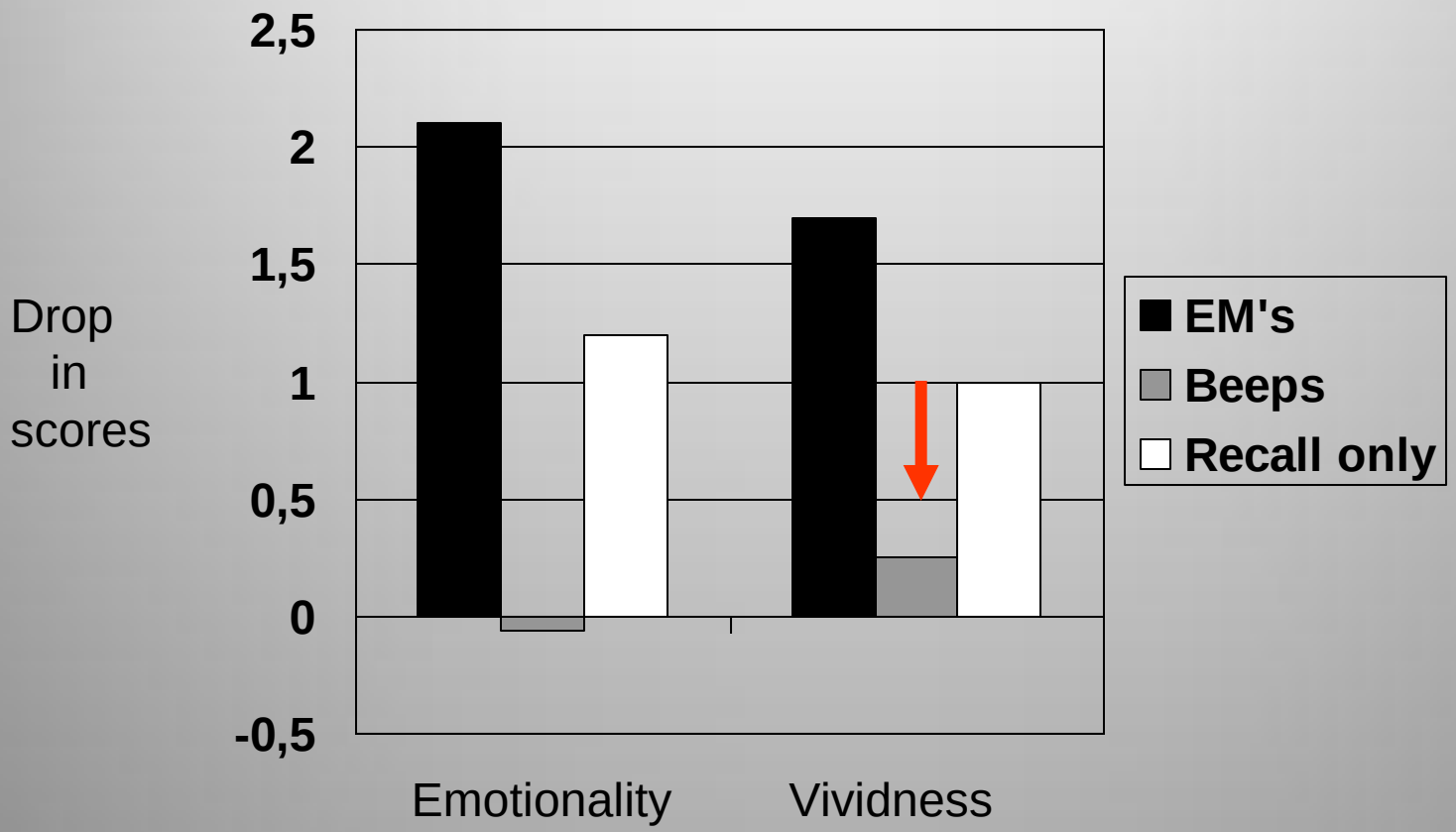
Van den Hout et al, Behav Res Ther, 2012



Van den Hout et al, Behav Res Ther, 2012


Drop in scores
2,5
2
1,5
1
0,5
0
-0,5
Emotionality
Vividness
EM's
Beeps
Recall only

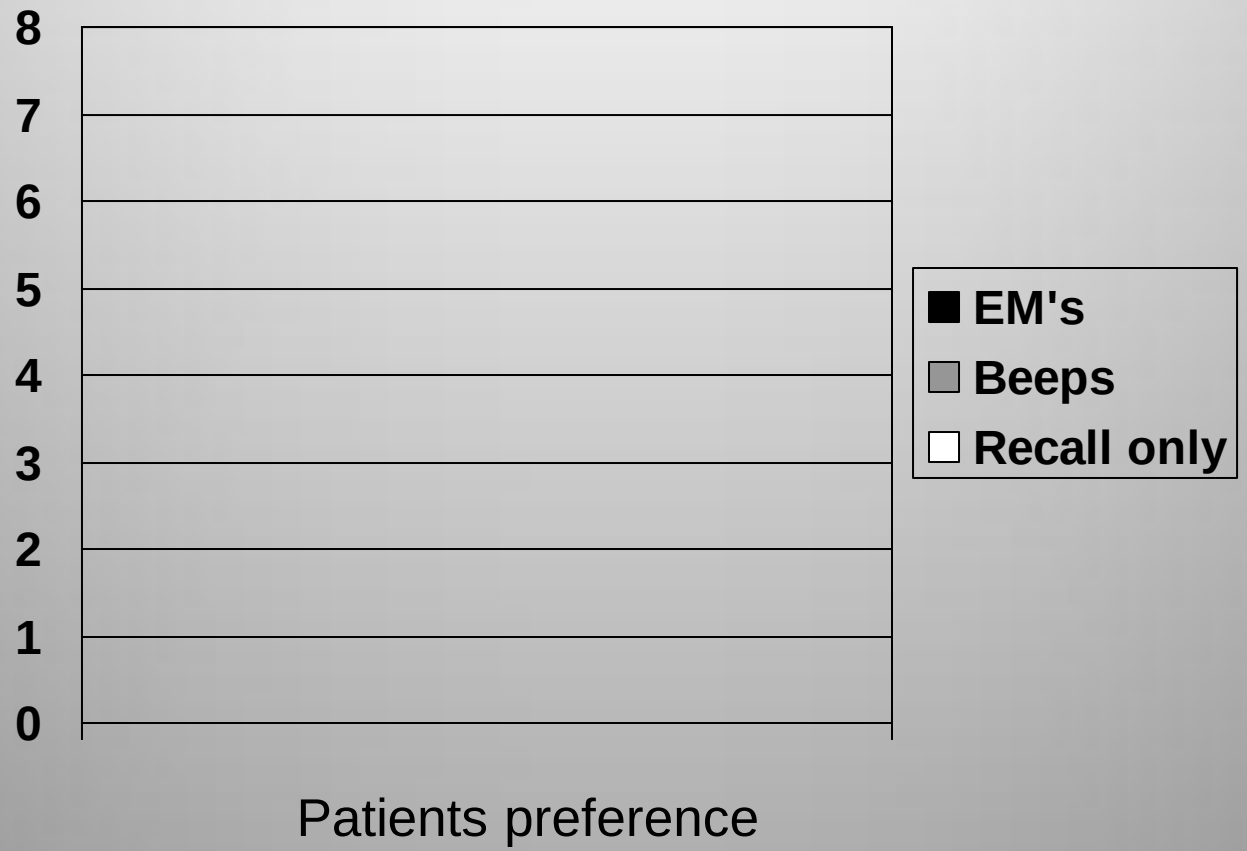

Drop in scores
2,5
2
1,5
1
0,5
0
-0,5
?
EM's
Beeps
Recall only
Emotionality
Vividness


Drop in scores
2,5
2
1,5
1
0,5
0
-0,5
Emotionality
Vividness
EM's
Beeps
Recall only

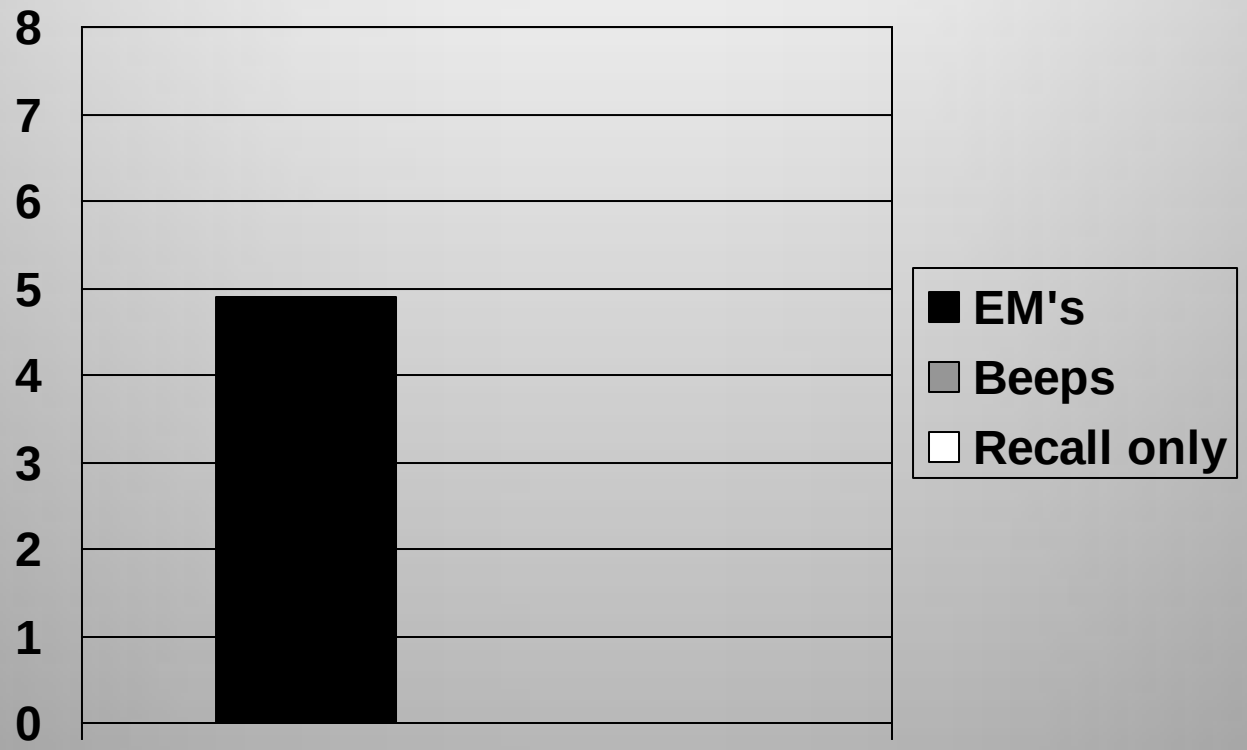
What about patient's *opinions* about

1) **Recall only?**
2) **Recall+ beeps?**
3) **Recall+ EM's?**

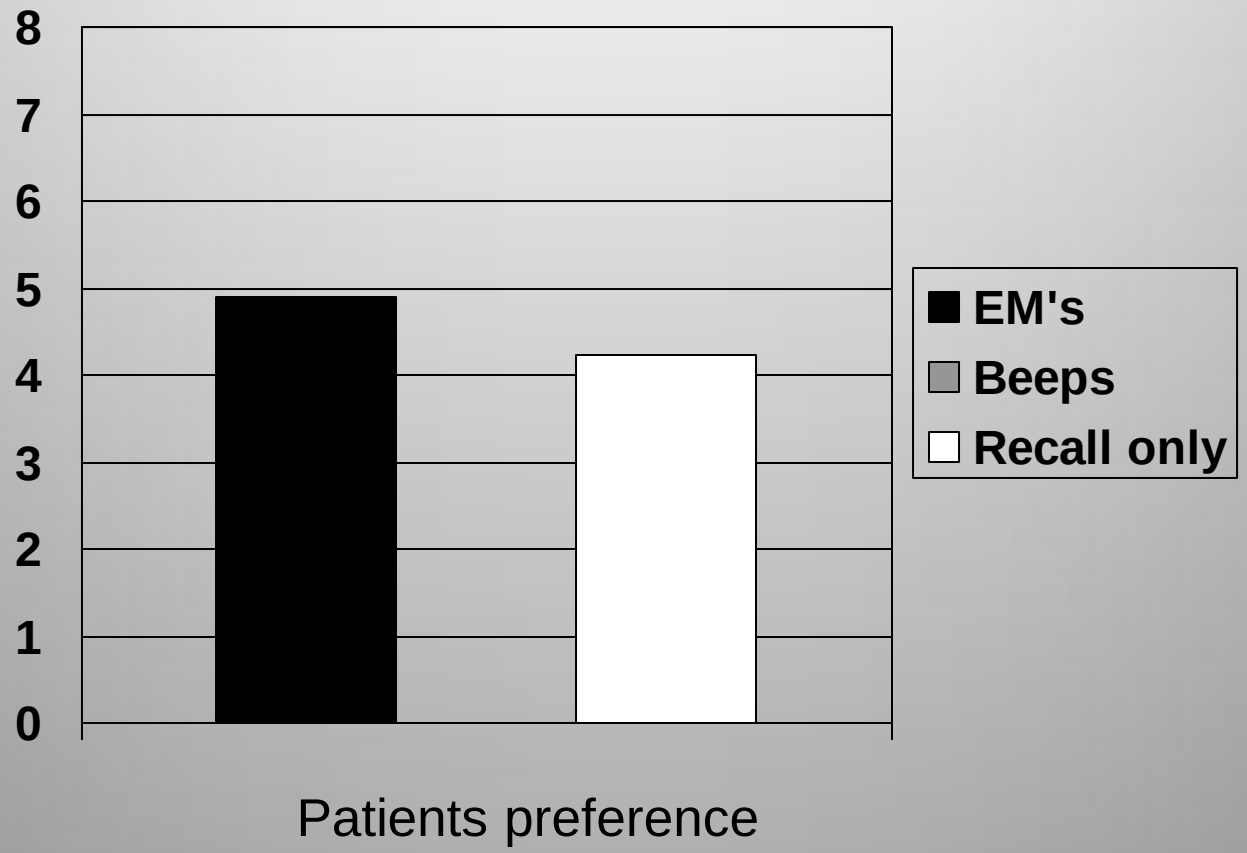
"How would you prefer to continue?"



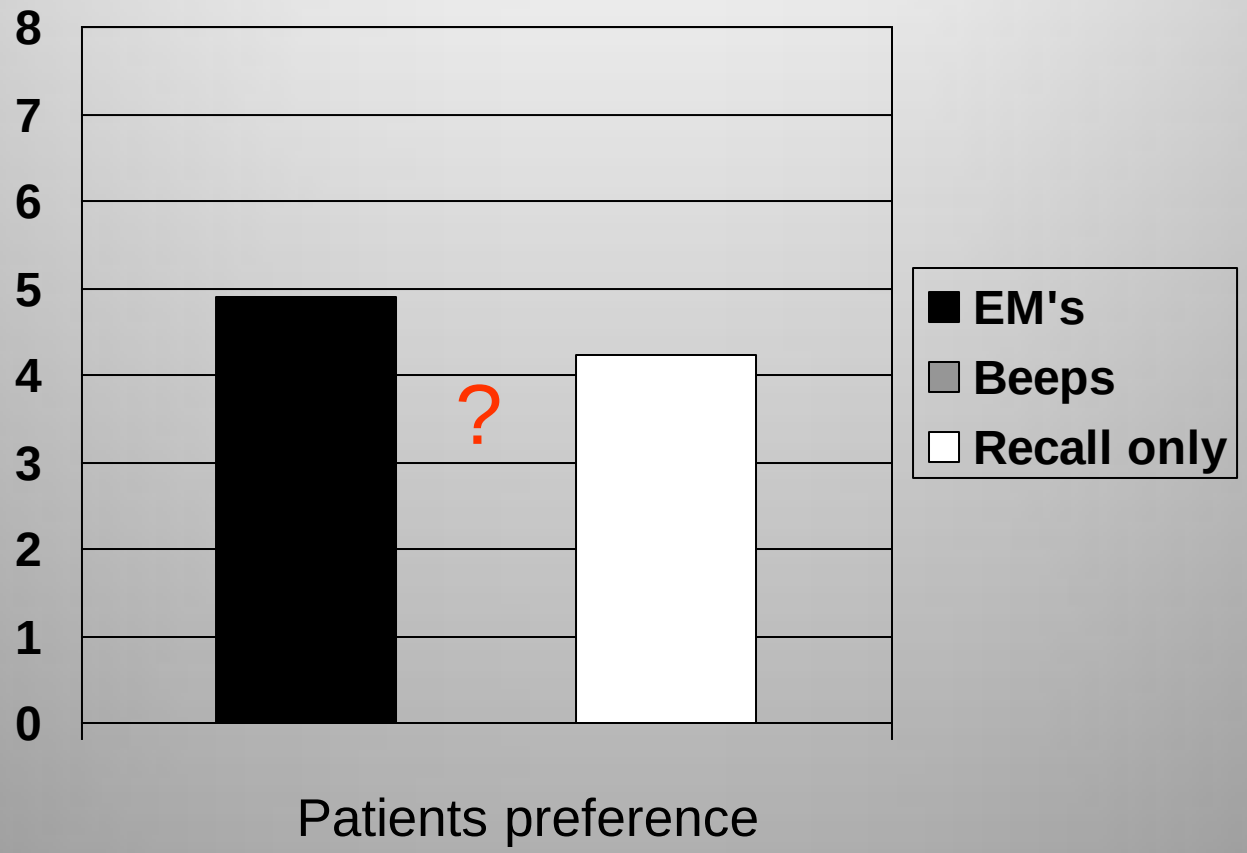
Patients preference



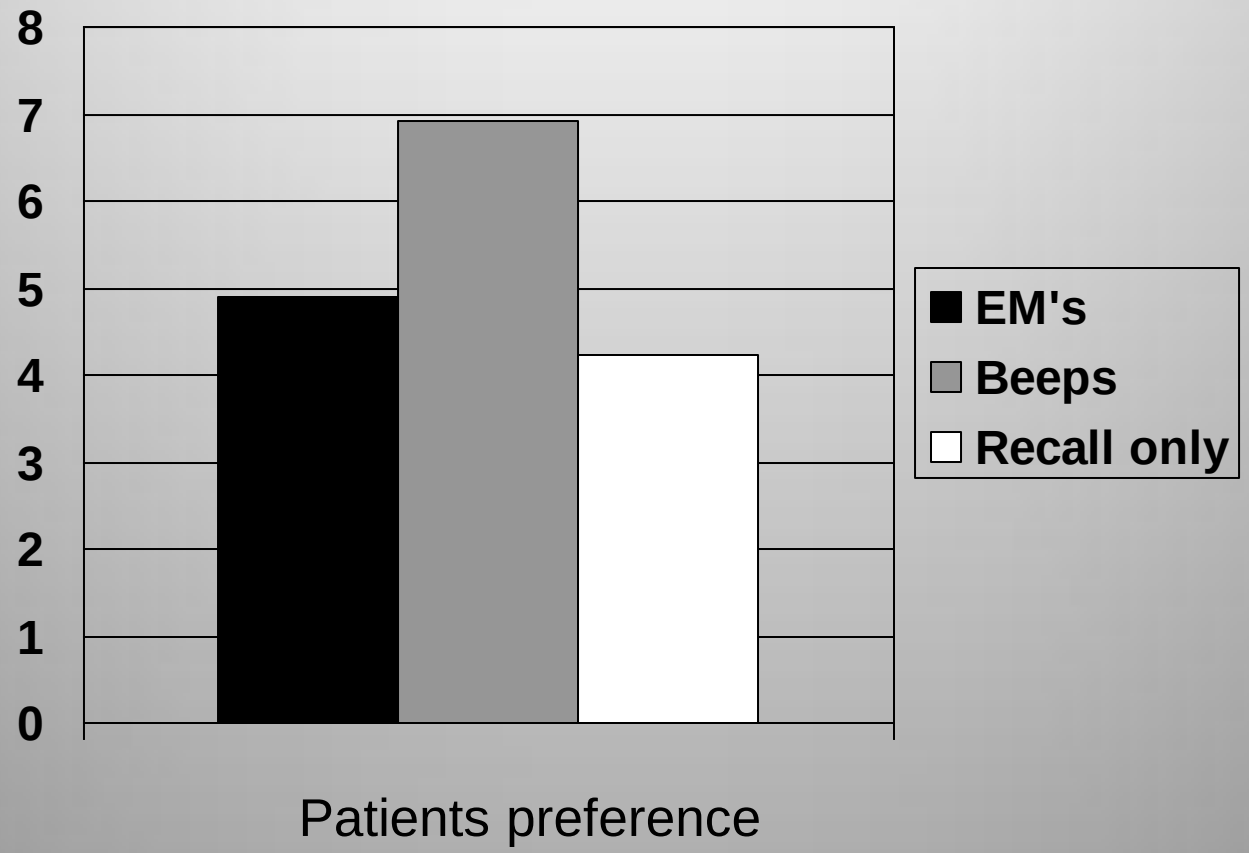
Patients preference



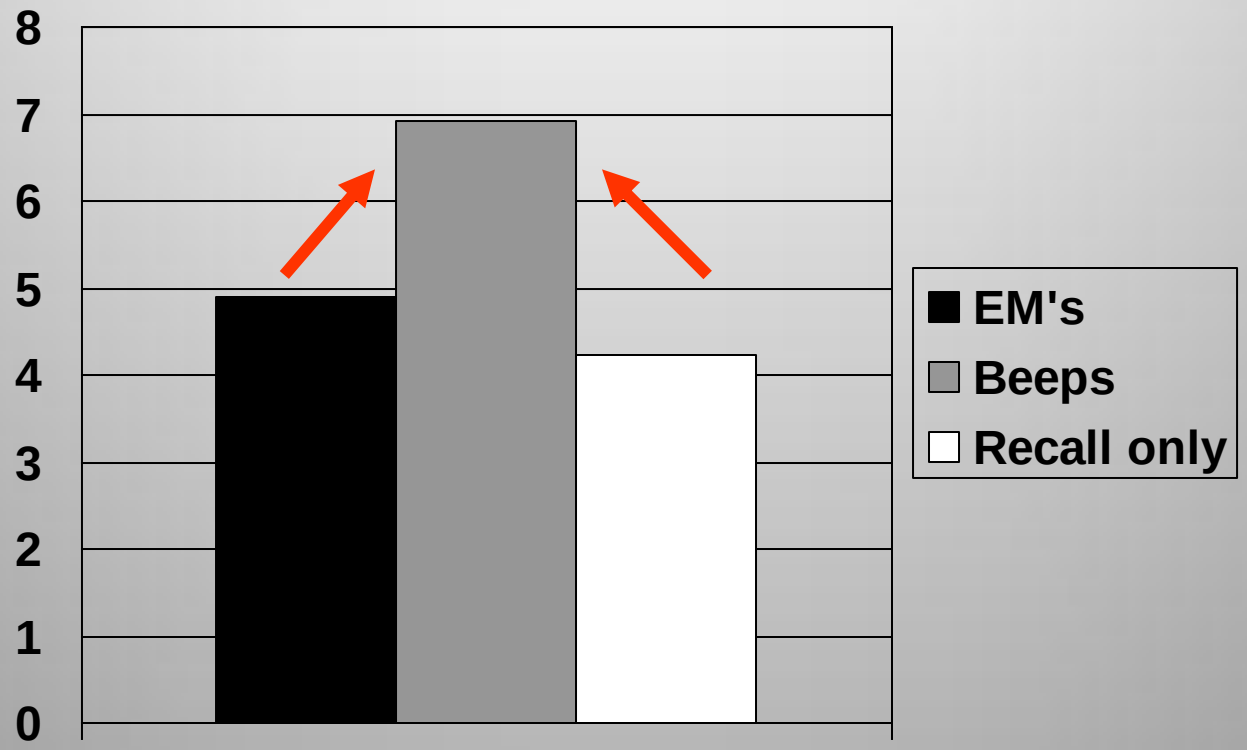
Patients preference



Patients preference



Van den Hout et al, Behav Res Ther, 2012



Patients preference

EM’s superior,
But patients preferred beeps.

Clinicians may infer effectivity from patients’ preference.

Clinical Issues

1) WM taxing during positive imagery/thoughts?

Implication: WM taxing during positive ideation is counterproductive.

2) Memories for future events and indication

Implication: theoretical and empirical basis for treating “flash forwards”

3) Using beeps instead of EM’s?

Implication: beeps inferior to EM’s

Summary

1) General. Trauma memory is plastic:

a) Emergence of trauma memories *after* PTSD (inflation)

b) Blurring of trauma memories in EMDR (deflation) in EMDR

2) Regarding EMDR:

a) Effects can be 'modelled' in lab.

b) Explanation: Not merely exposure.
Not interhemispheric communication.

c) Robuste evidence: deflation due to WM taxing.
during retrieval.

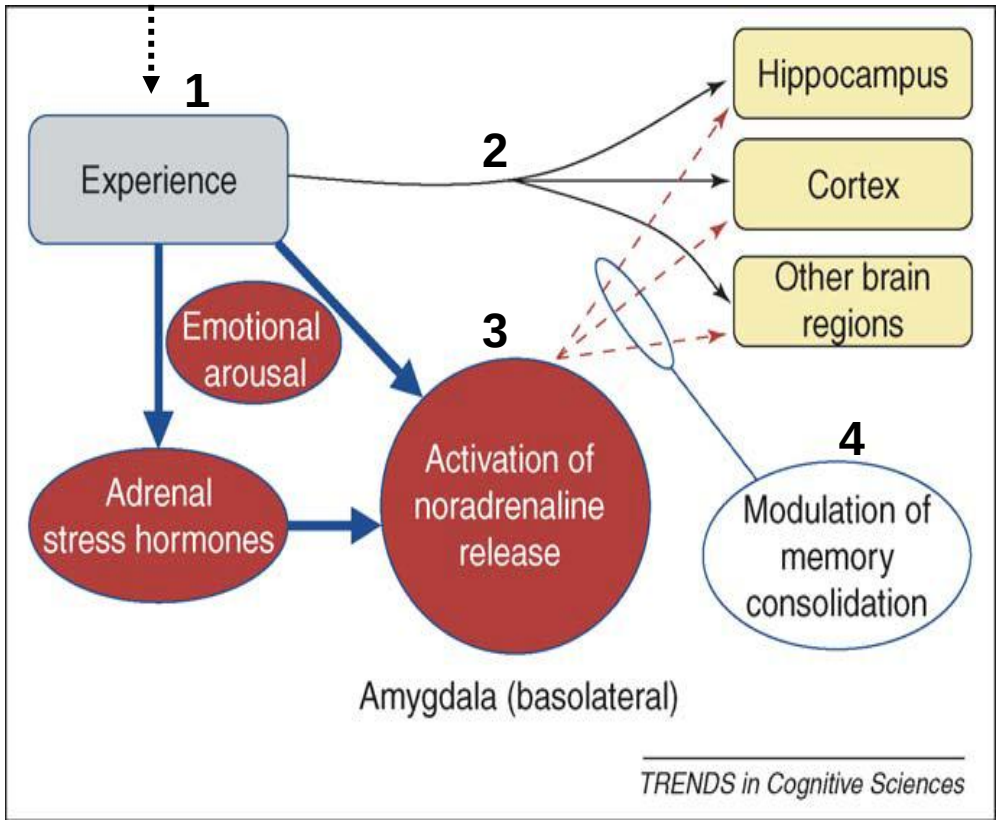
d) Rational basis for EMDR with clinical implications:

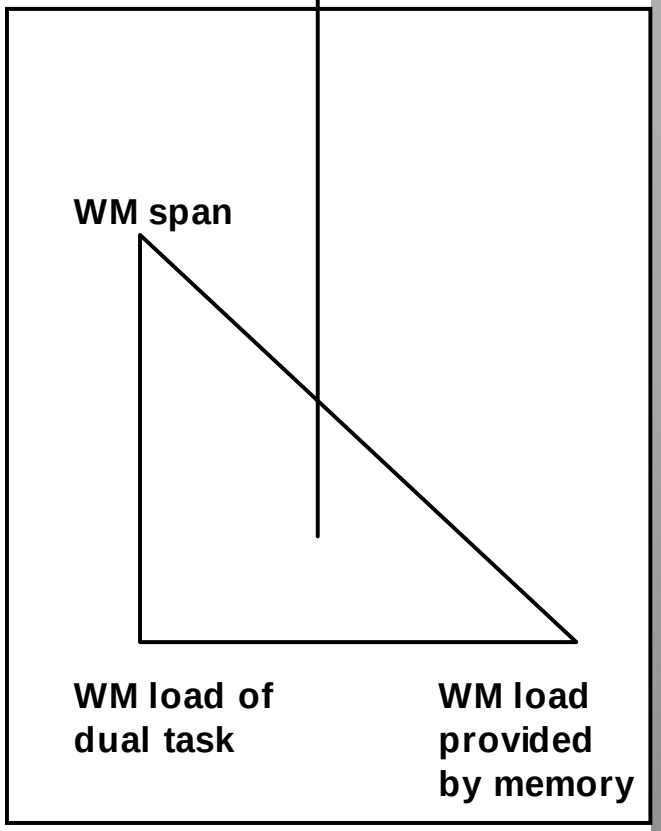
a) Dual tasking during positive imagery unfortunate

b) Flash forwards rational indication

c) Replacing EM's by beeps bad idea

Thank you !


1
Experience
2
Hippocampus
Cortex
Other brain regions
Emotional arousal
3
Adrenal stress hormones
Activation of noradrenaline release
4
Modulation of memory consolidation
Amygdala (basolateral)
TRENDS in Cognitive Sciences


WM span
WM load of dual task
WM load provided by memory