Working Memory and Emotion Regulation

What is working memory?

- Multi-component (Baddeley, 2007)
- Three storage systems
  - Phonological loop
  - Visuospatial sketchpad
  - Episodic buffer
- CENTRAL EXECUTIVE!

Subsystems

- Phonological Loop
  - Temporarily holds verbal and acoustic information
  - limited
- Visuospatial Sketchpad
  - Temporarily holds visual and spatial information
  - limited
- Episodic Buffer
  - Forms an interface between the above, long-term memory, and the central executive
  - limited

manipulating certain information to achieve a higher order

I look back at myself and see that I've somehow become a very broken person.

The Central Executive

- Assumed to allow for flexible, controlled processing of information in the service of one's goals

- Three major functions:
  - To allocate attention to task- or goal-relevant information
  - To enable the flexible, context-relevant manipulation of WM contents (i.e., updating WM)
  - To inhibit prepotent responses that may interfere with the present task or goal

Miyake et al. (2000)

- Administered a large battery of executive tasks
- Uncovered three latent constructs
  - Considerable overlap in variance, however
    - .4-.6
- Working memory capacity is closely linked to frontal lobe system functioning
    - Miller & Cohen, 2001; Stuss & Knight, 2002; Wager & Smith, 2003

Development

- WM improvements in childhood and adolescence are marked by "growth spurts" in frontal lobe development
  - Frontal lobes fully mature ~ age 19

will this process ever end?
am I at my most mature?

- Conversely, WM declines at more senior ages, corresponding with frontal lobe volume reduction

Measuring Working Memory Capacity (WMC)

- There are individual differences in WMC
  - The capacity with which the central executive can perform task-relevant operations on stored information, in the service of the task or goal at hand

- Lots of measures, but the Operation Span (OSPAN) is the prototypical measurement tool

The Operation Span (OSPAN)

- Secondary Processing task
  - Indicating whether a mathematical calculation is correct, via keypress ("3 + 5 = 9?")
- Primary Processing task
  - Remembering words ("dog")
- Three to eight trials prior to word recall
  - Score = # of words recalled fully successful blocks only
- Loads primarily on the updating function of WM
    - Miyake (2000)

Try OSPAN???

“Hot” Cognition

- Emotions, desires, urges, etc., involve automatic, “prepotent” responses
  - These are called “bottom-up” processes
- The extent to which these “hot” drives/emotions, etc. garner access to WM is dependent on:
  - The strength of this “bottom-up” activation
    - Stronger signals may garner more attention
  - Whether the “spotlight” of top-down attention is focused on the signal

working memory

WM modulates emotion

- To what effect? Either to:
- Amplify the “hot” experience, by endowing it with a richer set of cognitions (appraisal processes, etc.)
- Attenuate the “hot” experience via distraction (turning attention away from stimulus), reappraisal, etc.

What is self-regulation?

- Anything that involves the control of internal states and/or external behavior; overriding prepotent responses!
  - Controlling an emotion
  - Getting good grades
  - Losing weight
  - Abstaining from alcohol, drugs, etc.
  - Saving for retirement
  - Not procrastinating

Still learning
forever learning

haha . . .

- The list goes on, and on, and on, and on, and on . . .

How does WM aid self-regulation?

- By keeping an active representation of goals and goal-relevant information in WM
- By flexibly updating WM; keeping it focused on context-relevant information pertinent to the desired goal
- By inhibiting unwanted thoughts and emotional reactions that run counter to the goal
- By inhibiting/overriding unwanted behavioral responses

Maintaining focus on the goal

- Often referred to as the “standards” ingredient of self-regulation
  - What is the desired end-state?
  - What are the means by which and circumstances under which the goal can be attained?

내 삶의 목적이 흔들리고 있음

- Without the above, self-regulation will fail!

그냥 학교 다니고 싶다

끊어서 버리고 싶다

Maintaining focus on the goal

"I should do the readings again"

- Without the above, self-regulation will fail!
  - How so?
- The more accessible the goal representation, the greater the "biasing" effect on top-down control of behavior
  - It keeps you on the "right track"!
- But realize that distractions and temptations may cause self-regulatory goals to drift from WM!
  - The good news is that the goal representation in WM "narrows" the spotlight, making distractions/temptations less likely to be noticed or influence behavior

Goal shielding

- “Goal shielding is the ‘passive’ consequence of sustained attention to a goal or task . . . Its effects are akin to the way a flashlight illuminates the particular objects it is pointed at while at the same time leaving all other things in the dark.” (p. 4)

How does WM aid self-regulation?

- By keeping an active representation of goals and goal-relevant information in WM
- By flexibly updating WM; keeping it focused on context-relevant information pertinent to the desired goal
- By inhibiting unwanted thoughts and emotional reactions that run counter to the goal
- By inhibiting/overriding unwanted behavioral responses

The "monitoring" aspect of self-regulation

- Monitoring:
  - Current context/situation
  - One's inner states
  - One's actions
- Discrepancies between current states (emotions, behaviors, etc.) and goal states may be identified and resolved
  - E.g., noticing that one is drinking despite goal of wanting to drive sober

The "monitoring" aspect of self-regulation

- One can modify behavior
  - Stop drinking; make sure you leave after ensuring sobriety
- OR alter goals (Intelligent self-regulation involves flexibly adjusting plans when confronted with obstacles, etc.)
  - Call an Uber; have sober friend drive you home, etc.

How does WM aid self-regulation?

- By keeping an active representation of goals and goal-relevant information in WM
- By flexibly updating WM; keeping it focused on context-relevant information pertinent to the desired goal
- By inhibiting unwanted thoughts and emotional reactions that run counter to the goal
- By inhibiting/overriding unwanted behavioral responses

Inhibiting Thoughts / Emotions

- Rather intuitive
- For example, when trying to work on your relationship, you may want to reappraise an irritating comment your partner made
  - Decrease anger experience → increase harmony

Thought Suppression

- Be very, very careful!
- Wegner's long line of research shows that thought suppression:
  - Fails, by actually placing the attentional spotlight on that which you want to ignore
  - If successful in the short-term, produces an unwanted longer-term rebound effect
  - Requires an immense amount of mental energy, sapping mental resources
    - More on this later!

How does WM aid self-regulation?

- By keeping an active representation of goals and goal-relevant information in WM
- By flexibly updating WM; keeping it focused on context-relevant information pertinent to the desired goal
- By inhibiting unwanted thoughts and emotional reactions that run counter to the goal
- By inhibiting/overriding unwanted behavioral responses

Behavioral Inhibition / Impulse Control

- E.g., overriding unwanted behavioral responses

- Will this be successful? It depends on the relative strength of “top-down” and “bottom-up” processes!
  - Remind you of anything?!?!?!

Two ways to deplete WMC

- By adding simultaneous (secondary) demands on WM resources
  - Much research shows that executive functioning is compromised by secondary task loads
  - People become more impulsive when they have to perform simultaneous mental operations!
- "Ego depletion"
  - The exertion of self-control depletes self-control resources temporarily

WMC and attention control

- Attention is vitally important, as it has the chance to alter behavior by gaining access to WM!
  - One typically processes that which is attended to, right?
- Attention is typically bottom-up; we attend to salient, motivationally relevant stimuli
- BUT we also have some top-down control of attention, based on goal representations in WM
  - We may ignore the cigarette sign if we are trying to quit smoking
  - Or we may try to disengage from the cigarette sign if it automatically attracts our attention

Kane et al. (2001; Study 2)

- Using eye tracking, people with higher WMC were found to make less reflexive saccades on an anti-saccade task

Hofmann et al. (2008)

- Among heterosexual males, assessed automatic affect to semi-nude women using the Implicit Association Test (IAT; IV)
- Viewing time of semi-nude women (relative to control pictures) was DV
- OSPAN was used as a measure of WMC (moderator)
- Automatic affect positively predicted viewing time for low-WMC individuals only!
  - Suggests that persons with higher WMC were able to override prepotent responses

Friese et al. (2009)

- Showed exact same thing in both males and females, but used alcohol stimuli instead

WMC and Thought Control

- As we know, this is risky business . . .
- BUT, people with higher WMC (OSPAN) are better able to suppress thoughts
  - White bears (Brewin & Beaton, 2002)
  - Personally relevant intrusive thoughts (Brewin & Smart, 2005)
- The ability to purge thoughts ("I bet that X is great!") may be particularly important to goal attainment ("I'm trying to avoid X")

WMC and emotion control

- Schmeichel, Volokhov, & Demaree, 2008
- Schmeichel & Demaree, 2010

SV&D, 2008

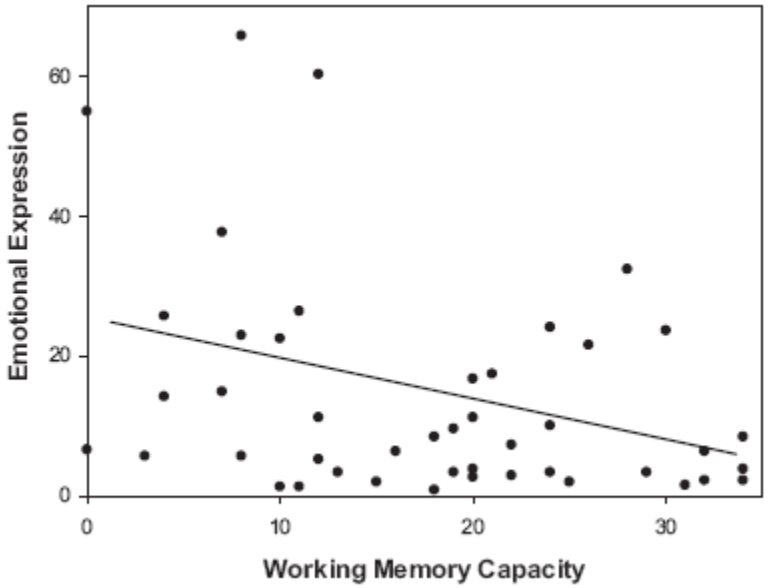
- Four studies
- Studies 1 & 2 on emotional suppression
- Studies 3 & 4 on emotional reappraisal

Study 1

- Used Berkeley Emotional Expressivity Questionnaire (BEQ) to assess negative expressivity
- Used OSPAN to assess WMC
- Watched 2-minute film from Faces of Death (of an animal slaughterhouse)
- Asked to suppress facial response to movies
- Faces video-recorded for subsequent analysis (1 to 100)
- Following video, negative emotional responses were assessed using the UWIST Mood Adjective Checklist

Study 1 Results

- People with higher WMC were better able to suppress their facial expressions



- OSPAN did not predict BEQ or UWIST

Study 1 Problems

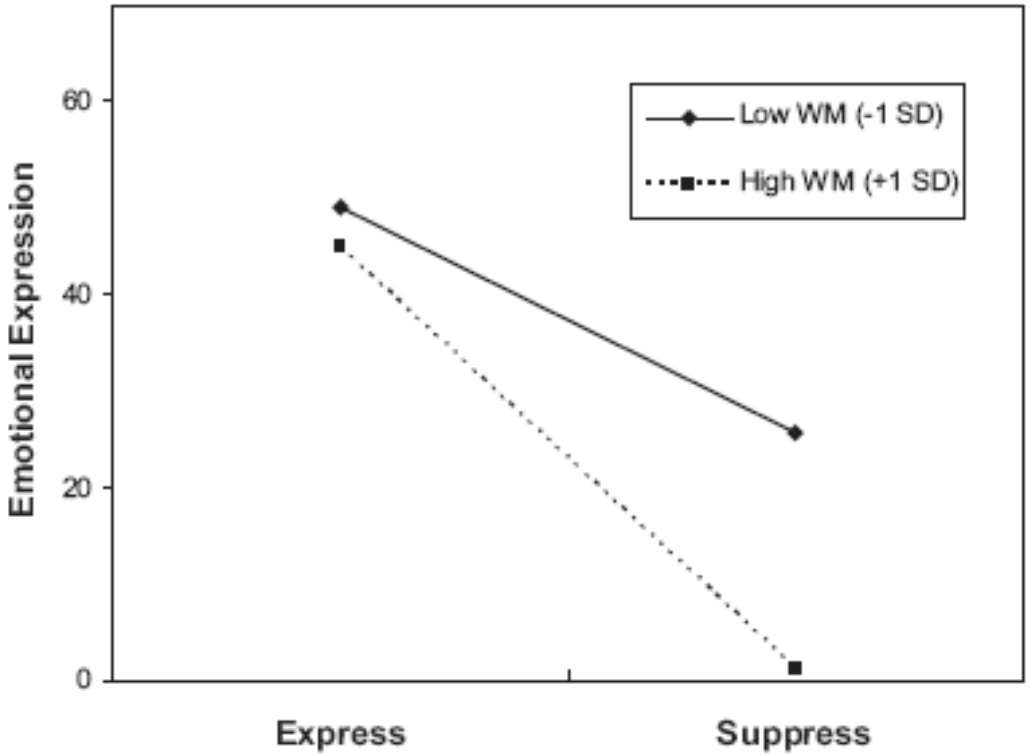
- Just to negative stimuli
  - Positive stimuli?
- People with higher WMC may simply be less expressive
  - Need control condition

Study 2

- Used BEQ to assess positive expressivity
- Used OSPAN to assess WMC
- Watched 2-minute amusing film from *Jay Leno Show*
  - Asked to suppress facial response to movies
  - Or not
- Faces video-recorded for subsequent analysis (1 to 100)
- Following video, positive emotional responses were assessed using the UWIST

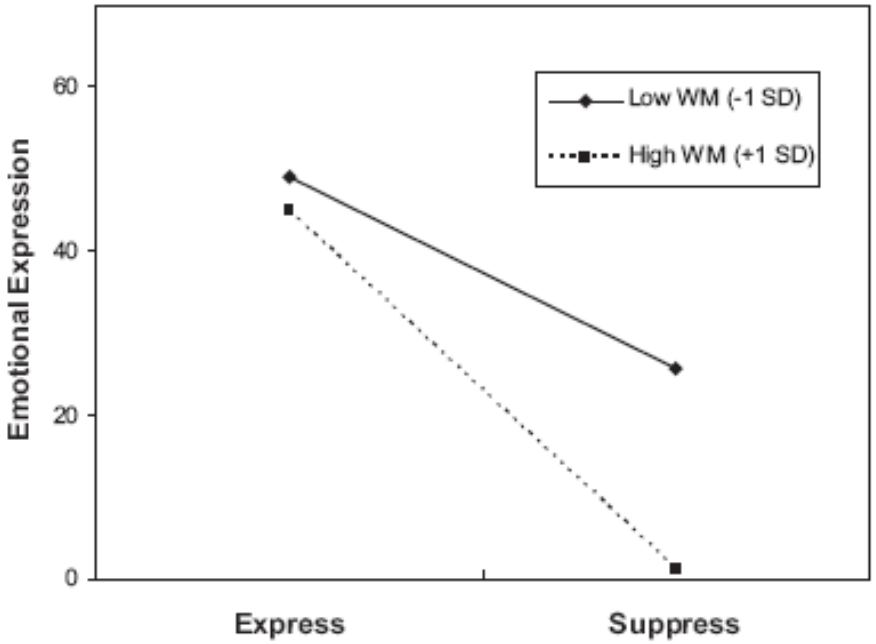
Study 2 Results

- Main effect of Condition (Suppress versus Natural)



Study 2 Results

- Main effect of Condition (Suppress versus Natural)



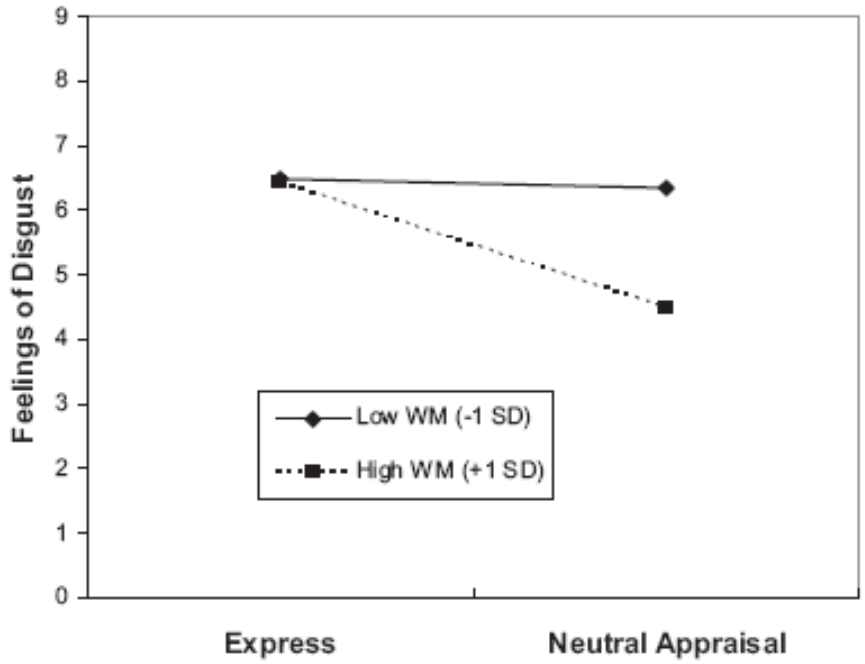
- Controlling for BEQ and UWIST

Now on to reappraisal – Study 3

- Used BIS/BAS to measure emotional responsivity
- Used 2-back task to assess
  - http://www.cogstate.com/go/clinicaltrials/our-tasks/two-back-task
- Watched 2-minute Faces of Death film
  - Either reappraising
  - Or natural-watch
- Faces video-recorded for subsequent analysis (1 to 100)
- Following video, emotional responses were assessed using the Discrete Emotions Questionnaire (DEQ; including disgust)

Study 3 Results

- WMC * Condition interaction effect on disgust rating



- Controlling for BIS

Study 3 Results

- But NO WMC * Condition interaction effect on emotional expression

Study 3 Problems

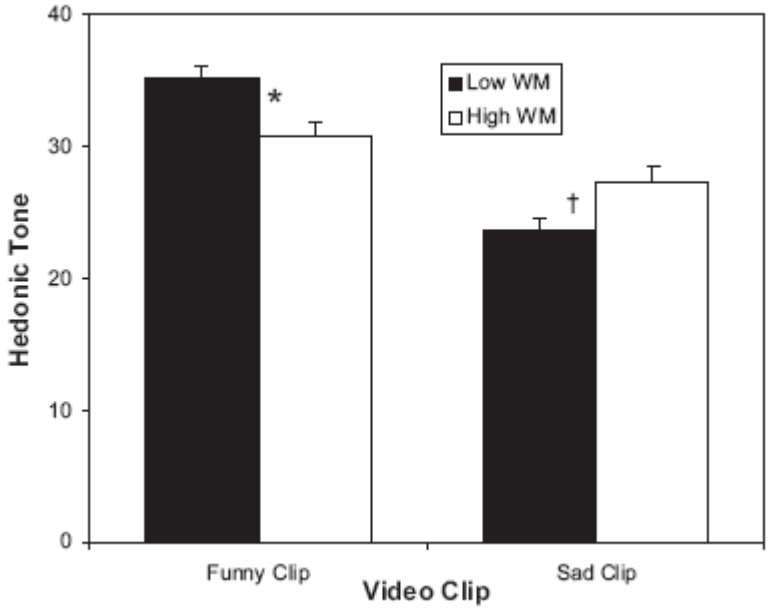
- Just to negative stimuli
  - Positive stimuli?
- No influence of WMC on emotional expression

Study 4

- USED EXTREME GROUPS APPROACH!
- Used OSPAN to assess WMC during Session 1
  - Lowest and highest 21 scorers were invited back for emotion induction
- Watched either 2-minute sad film (depictions of family deaths, etc.) or 2-minute amusing film (Study 2)
  - Instructed to reappraise
- Faces video-recorded for subsequent analysis (1 to 100)
- Following video, negative and positive emotional responses were assessed using the UWIST Mood Adjective Checklist

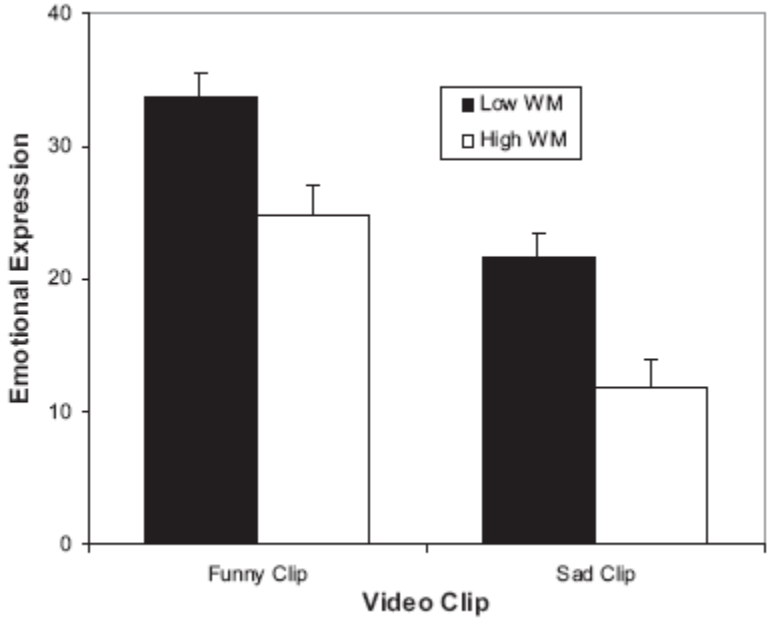
Study 4 Results

- Significant main effect of movie on hedonic tone (positive relative to negative emotions reported)
- Significant WMC * Movie effect on hedonic tone



Study 4 Results

- Significant main effect of movie on emotional expression
- Significant WMC * Movie effect on facial expression



What about *spontaneous* emotion regulation????

Schmeichel & Demaree, 2010

Why study this?

- Scientifically, perhaps high WMC individuals are simply better following directions
  - Consistent with Engle, Carullo, & Collins, 1991
- Pragmatically, as previously mentioned, spontaneous ER may be more generalizable!

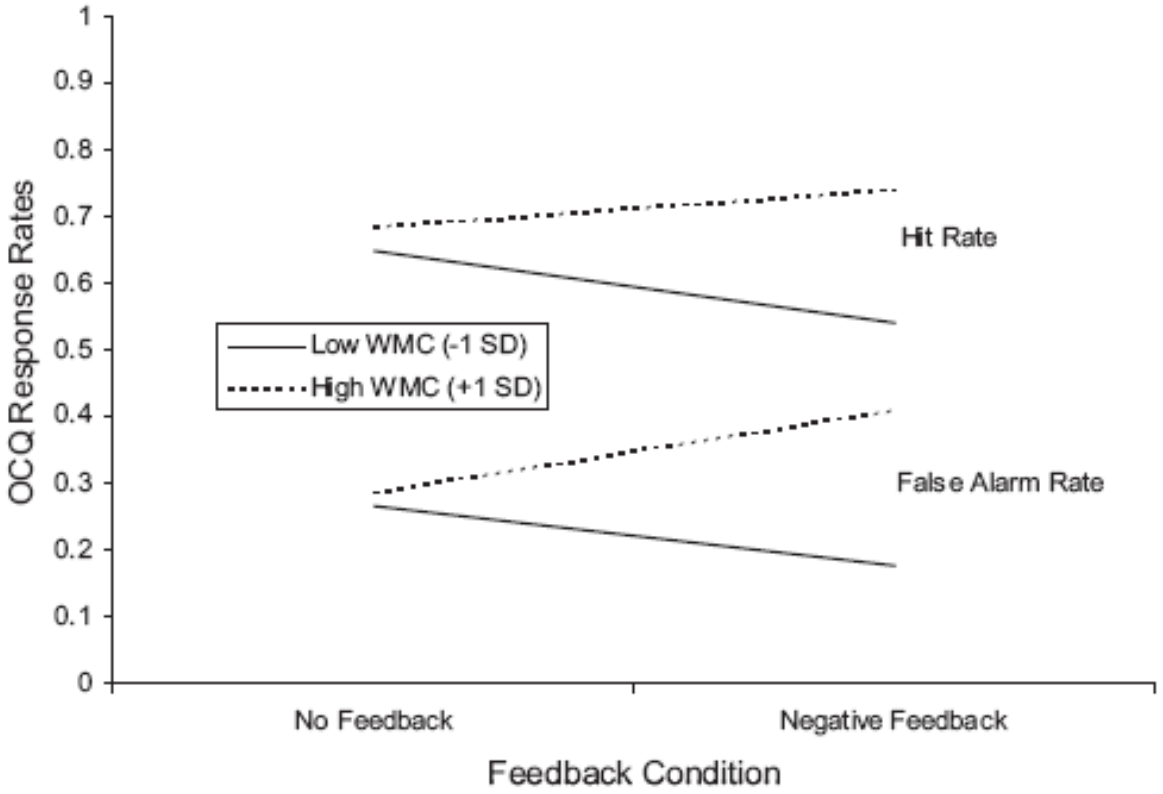
Schmeichel & Demaree, 2010

- Session 1
  - PANAS to measure PA and NA
  - OSPAN to measure WMC
- Session 2
  - Die roll to "determine order of testing"
  - Emotional intelligence test about socioemotional preferences
    - No feedback or negative feedback
  - Crystallized intelligence measure which was actually the Over-Claiming Questionnaire (OCQ)
    - 72 real items and 18 "foils" rated from 0 (*not familiar at all*) to 6 (*completely familiar*)
  - PANAS to measure PA and NA

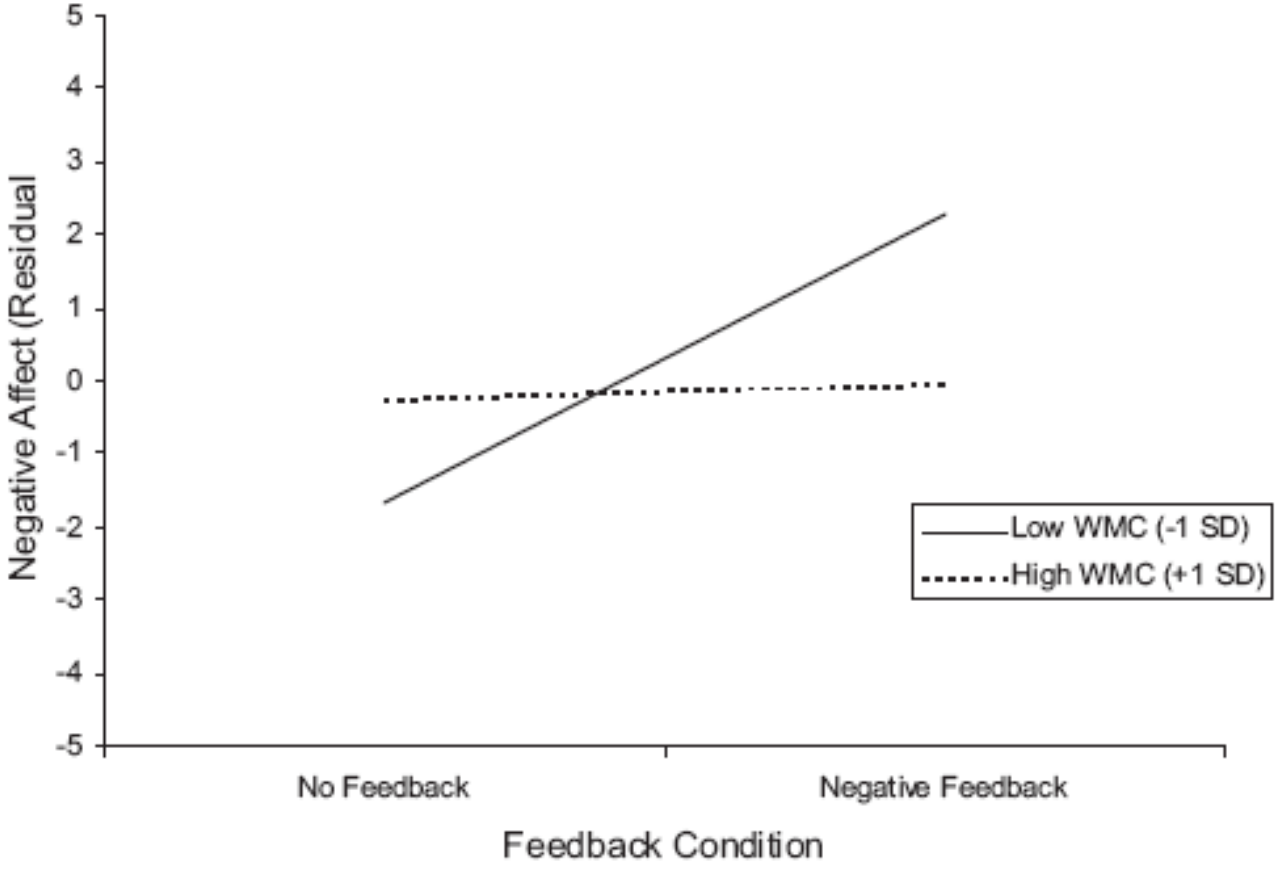
OCQ Scoring

- Many different ways to score, but “common sense” method includes:
- Accuracy
  - Hit rate (% familiarity with actual items) – false alarm rate (% familiarity with foil items)
- Self-enhancing response bias
  - “Yes rate” (Hit rate + false alarm rate)

Results – OCQ


OCQ Response Rates
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Low WMC (-1 SD)
High WMC (+1 SD)
Hit Rate
False Alarm Rate
No Feedback
Negative Feedback
Feedback Condition

Results – Negative Affect



What does this mean?

- People with higher WMC automatically use a strategy to help them feel good about themselves
- Only used with when confronted with negative feedback
- Helps them “stay more positive” (or, at least, avoid more negative!)