

# Neurobehavioral understanding of empathy in prolonged grief reactions

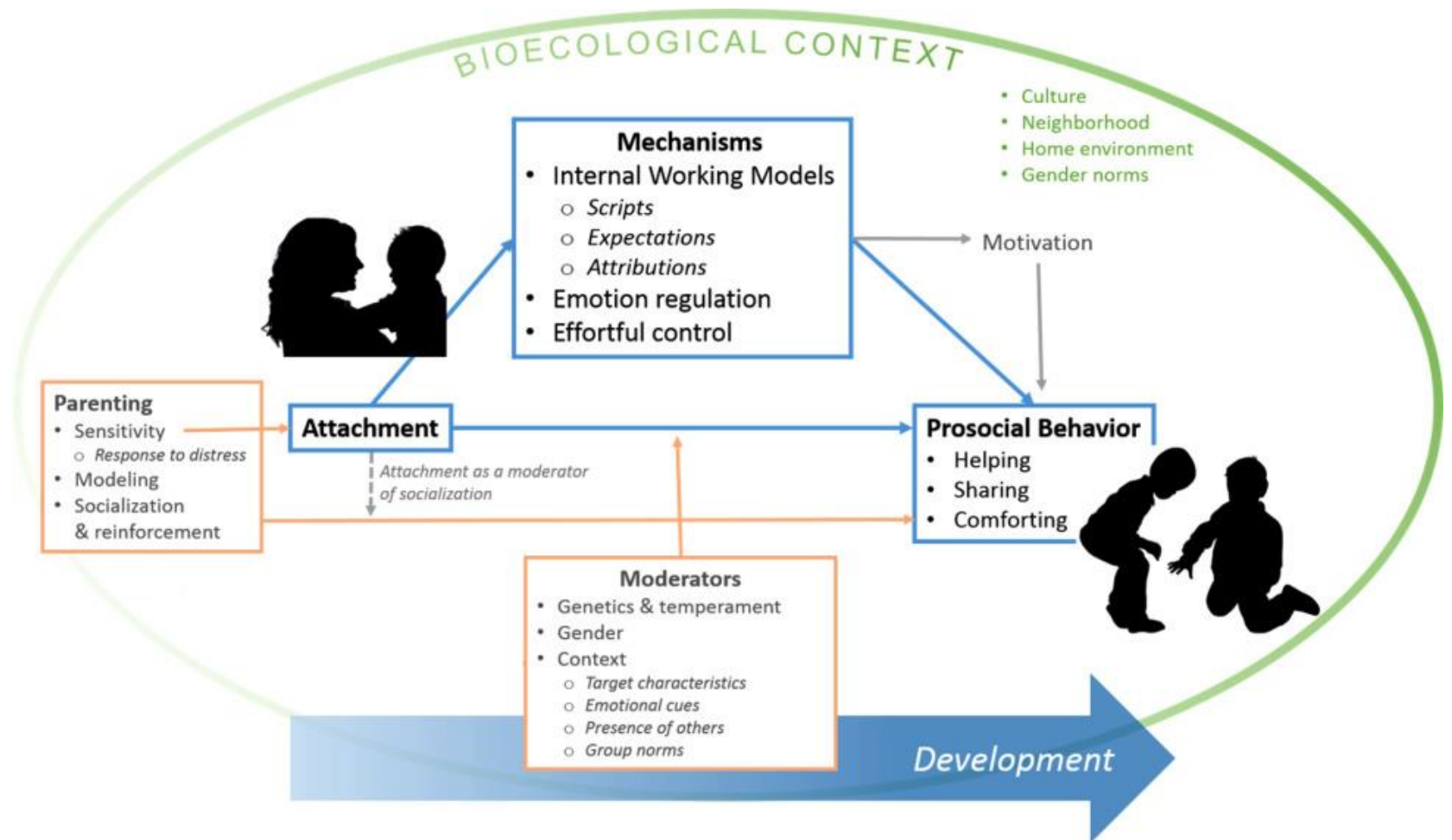
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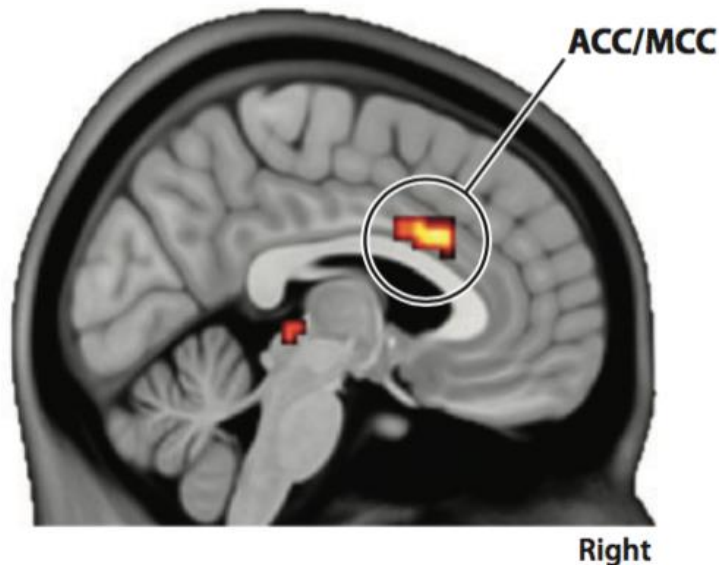
*National Institute of Mental Health,*

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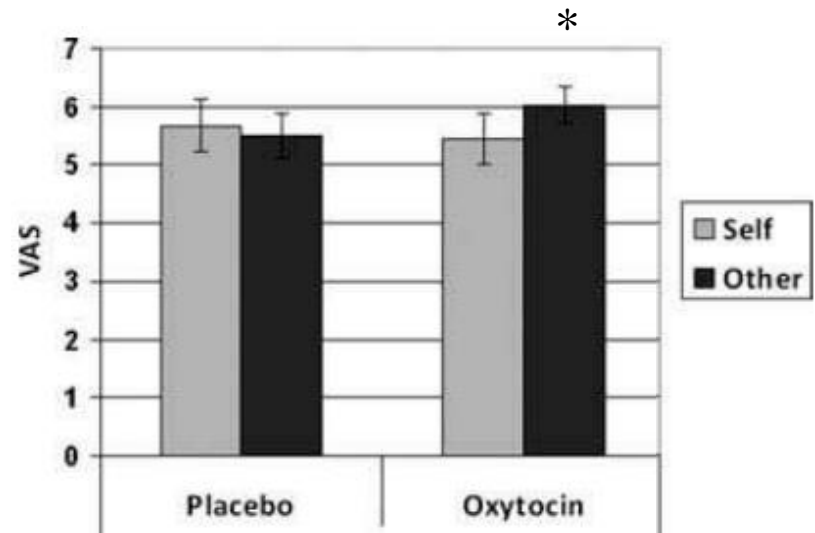
# Theoretical links between attachment and prosocial behavior



# Pain empathy—*vicarious experience of others' pain*—as a prosocial behavior







The neural basis of empathy  
Bernhardt & Singer *Annu Rev Neurosci* 2012

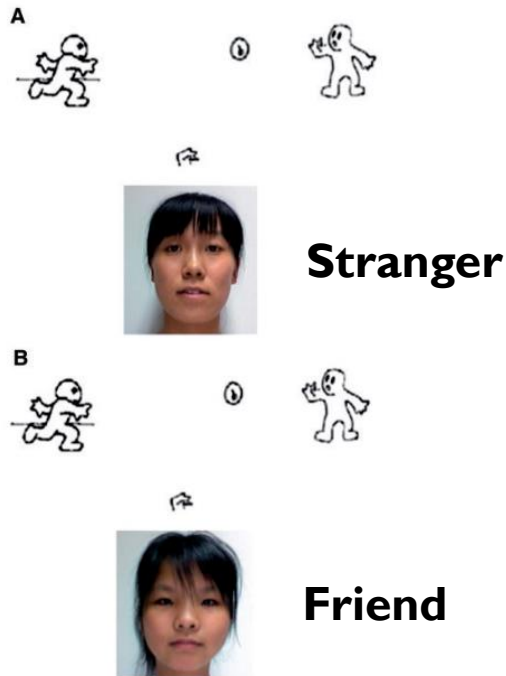


Oxytocin enhances pain empathy  
Abu-Akel et al. *Soc Neurosci* 2015

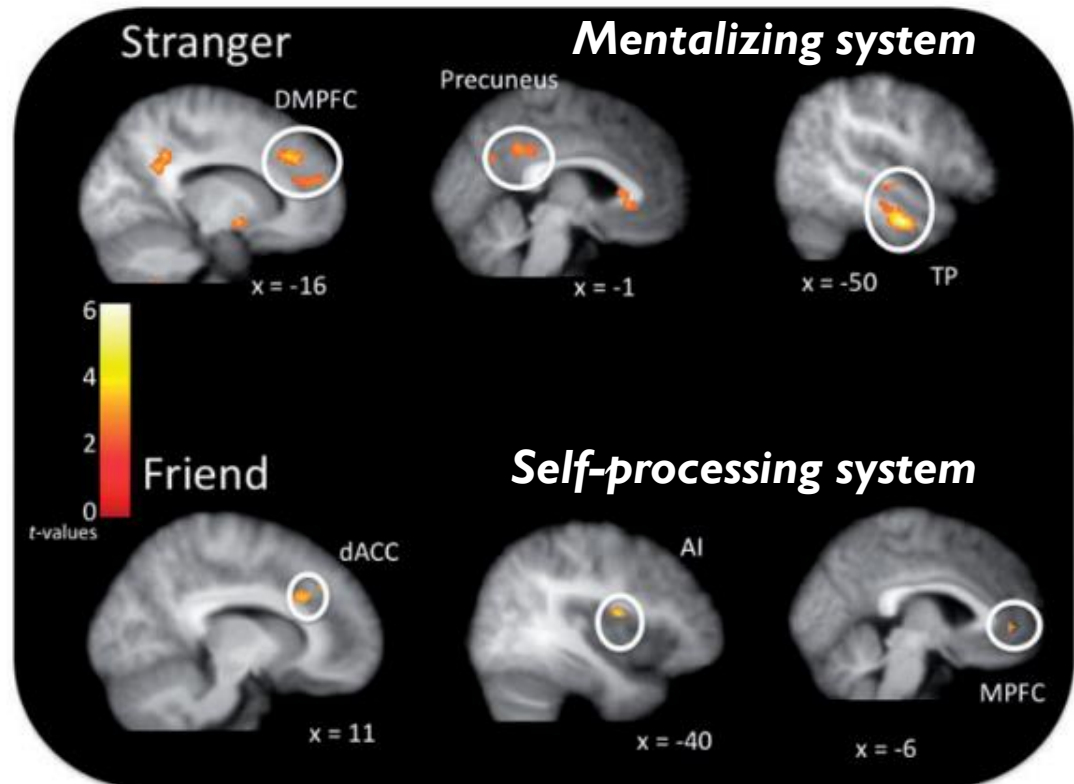
# Behavioral manifestations of animal empathy

	Behaviour	Definition	Mechanisms	
<b>a</b>		Mirroring	Rapid face matching and movement mapping	Motor mimicry
<b>b</b>		Yawn contagion	Yawning in response to another's yawns	Motor mimicry
<b>c</b>		State matching	Sharing the emotional state of another	Emotional contagion
<b>d</b>		Consolation	Comforting a distressed party	Empathic concern that is based on emotional contagion and requires self-regulation

# Social relatedness or closeness matters

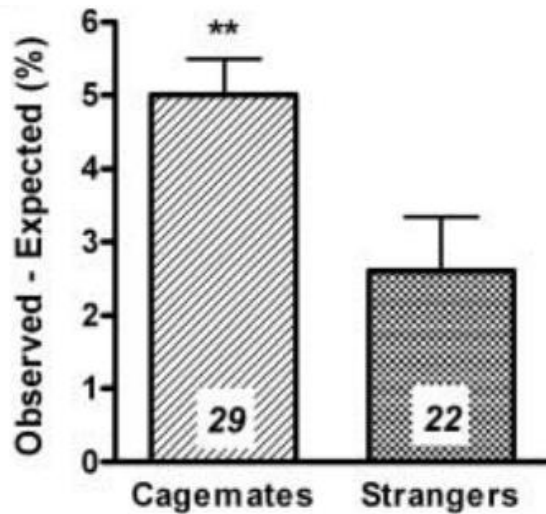


Cyberball task:  
A participant observes a close friend or stranger being socially excluded



Regions associated with empathizing for a friend and stranger's social exclusion

# Social modulation of pain as evidence for empathy in mice



Writhing behavior

Co-occurrence in writhing behavior was more frequent in the **Cagemates Condition** than in the **Strangers Condition**

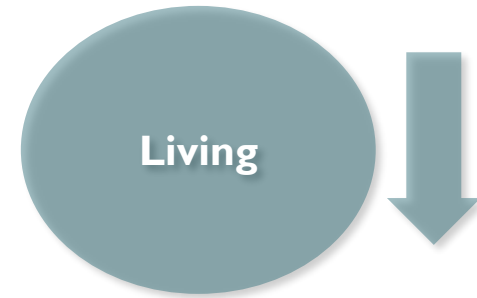
Langford et al. *Science* 2006

**Closer relationship, greater empathy**

# *Hypothesis:* Prolonged Grief and Empathy Bias



Continue to feel close  
to the deceased



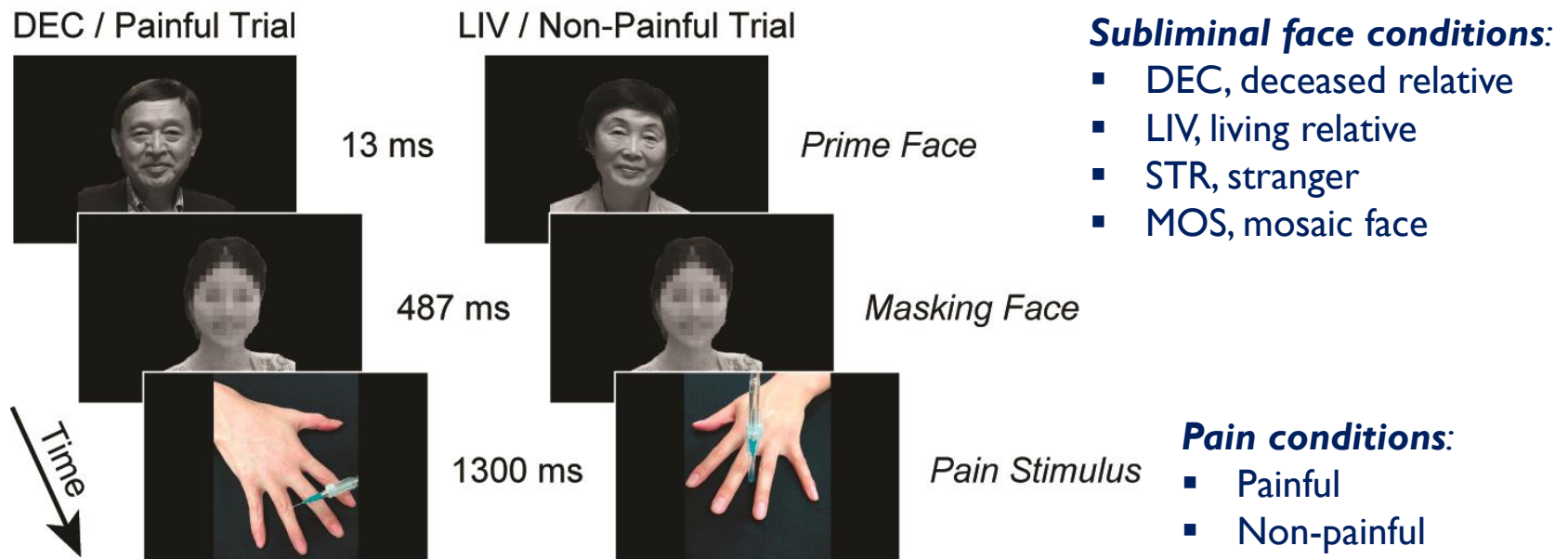
Continue to feel detached  
from other people

Empathy would be enhanced for deceased's pain  
but diminished for living relatives' pain despite similar closeness



Difficulty maintaining or rebuilding social bonds  
with others other than the deceased

# Modified pain empathy paradigm: *Face–empathy task*



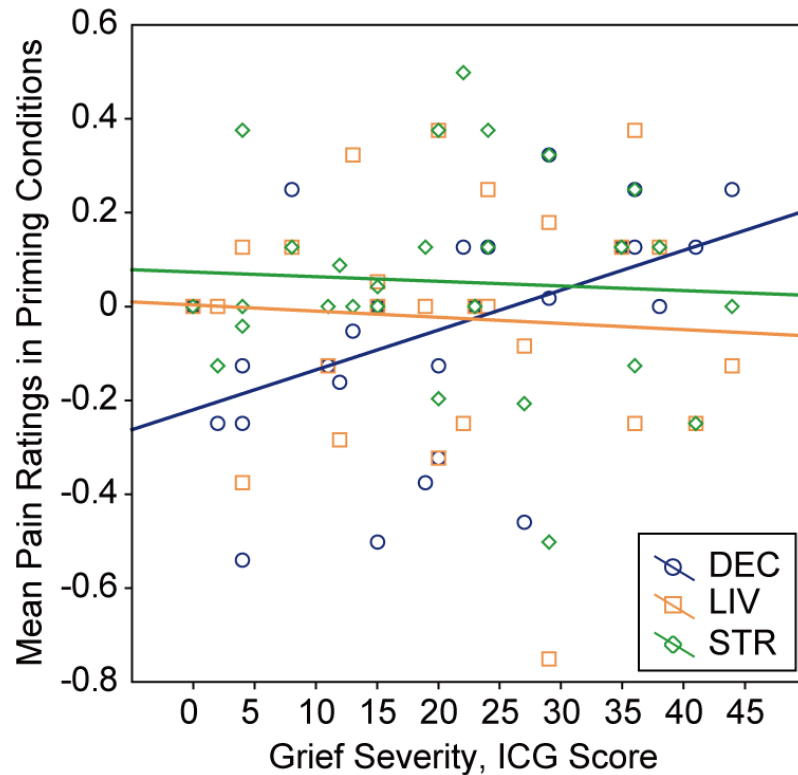
We assessed the effects of daily grief severity and subliminal facial stimulus on pain empathy at the behavioral (*pain ratings*) and neural levels (*fMRI*).



# Characteristics of Participants

Characteristic	<i>n</i> = 28
Age, years	49.5 (10.8)
Men / Women, n	2 / 26
Right-handed, n (%)	26 (92.9)
Time since loss, years	8.5 (9.2)
Education, years	13.8 (1.4)
Age of person who died, years	55.3 (27.2)
Child or spouse of the bereaved, n (%)	11 (39.3)
Sudden or violent loss, n (%)	14 (50.0)
Grief symptoms, Inventory of Complicated Grief score	19.8 (13.1)
Depression symptoms, Beck Depression Inventory-II score	10.7 (7.7)
Posttraumatic stress symptoms, Impact of Event Scale-Revised score	14.5 (14.6)
Psychiatric medication use, n (%)	5 (17.9)

# Grief enhanced empathy for pain in the deceased condition



Effects of grief symptoms on pain ratings differed by the face conditions

Face x Grief:  $F = 4.11$ ;  $P = .022$

Higher grief severity, higher pain intensity in DEC

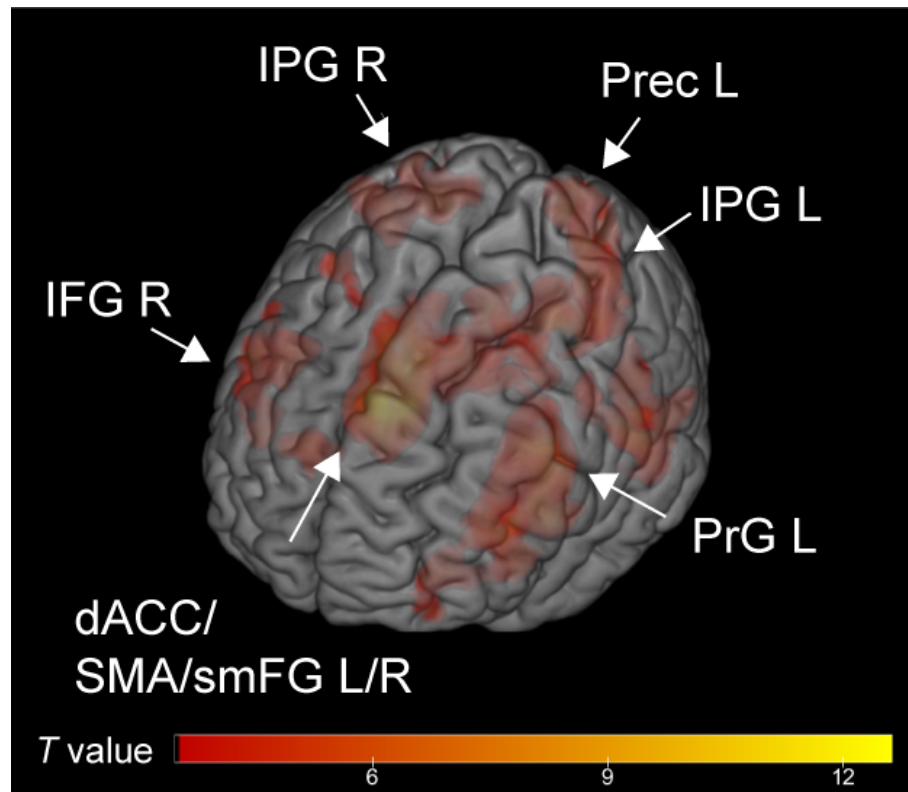
$\chi^2 = 6.97$ ;  $P = .008$

Significant while controlling for comorbid depressive and posttraumatic stress symptoms

Pain ratings in LIV and those in STR were moderately correlated

$r = .58$ ,  $P = .001$

# Pain empathy-related regions as a mask (painful vs non-painful conditions)



Clusters shown are false discovery rate whole-brain corrected at  $p < .05$ .

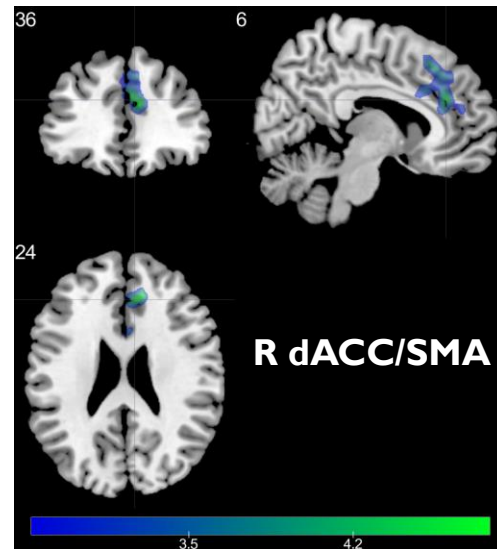
dACC, dorsal anterior cingulate cortex; IFG, inferior frontal gyrus; IPG, inferior parietal gyrus; L, left; Prec, Precuneus; PrG, precentral gyrus; R, right; SMA, supplementary motor area; smFG, superior medial frontal gyrus.

# Grief suppressed activation in empathy circuits in the LIV and STR conditions

## DEC

No clusters

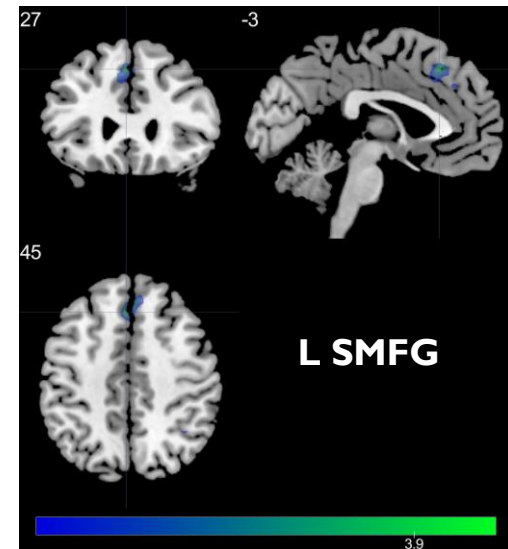
## LIV



**Negative association**

$T = 4.78, P_{FWE} = .002, k = 143$

## STR



**Negative association**

$T = 4.13, P_{FWE} = .021, k = 94$

Clusters shown are false discovery rate whole-brain corrected at  $p < .05$ .  
Significant while controlling for comorbid depressive and posttraumatic stress symptoms

Activation in LIV and that in STR were strongly correlated ( $r = .97, P < .001$ )

# Multidimensional constructs of grief

*Yearning*

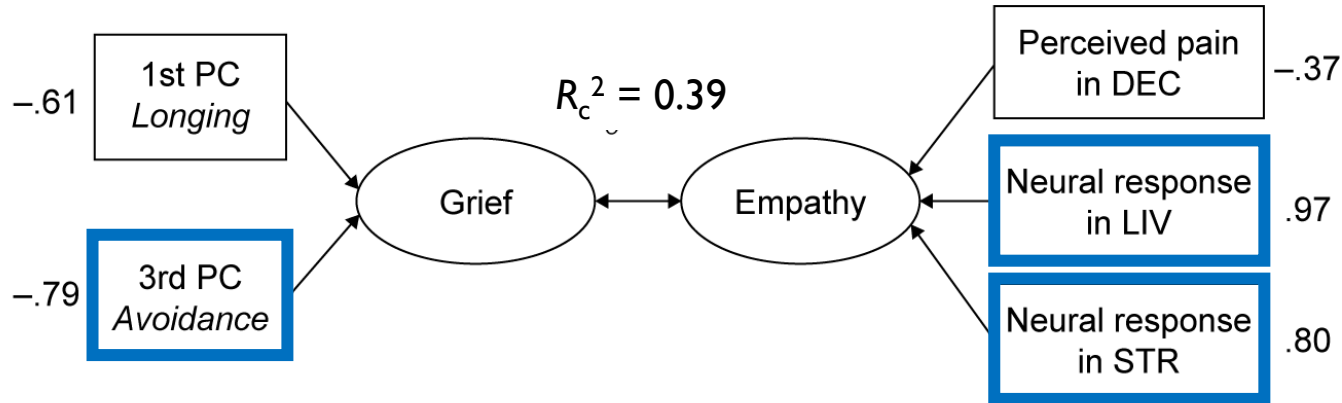
*Hallucination*

*Avoidance*

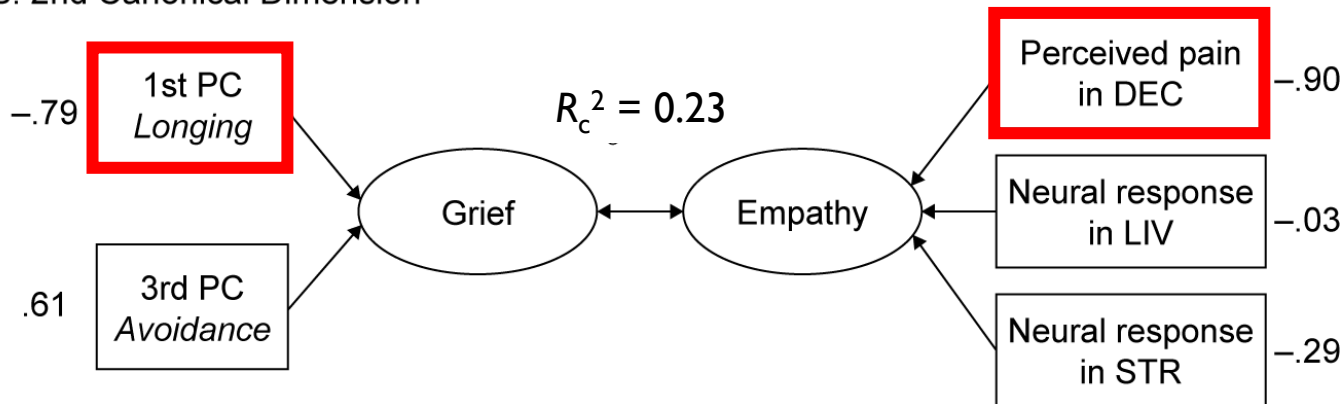
Inventory of Complicated Grief Item	Principal Component		
	1st	2nd	3rd
1. Preoccupation with the deceased	0.75		
2. Memories of the deceased upset me	0.87		
3. Nonacceptance of the death	0.75		
4. Longing for the deceased	0.90		
5. Drawnness to places or things related to the deceased	0.42		
6. Anger about the death	0.76		
7. Disbelief over what happened	0.73		
8. Feeling stunned or dazed	0.79		
9. Difficulty trusting people	0.74		
10. Feeling distant from people	0.73	-0.47	
11. Physical pain	0.56	0.66	
12. Avoidance of reminders of the deceased	0.57	0.40	-0.49
13. Emptiness without the deceased	0.81		
14. Auditory Hallucination		0.71	
15. Visual Hallucination	0.46	0.52	
16. Feeling unfair that I should live when the person died	0.73		
17. Bitterness over the death	0.84		-0.40
18. Feeling envious of others who have not lost someone close	0.70		-0.42
19. Loneliness since the loss	0.84		

# Different contributions of “avoidance” vs “longing” to grief–empathy relationship

A. 1st Canonical Dimension

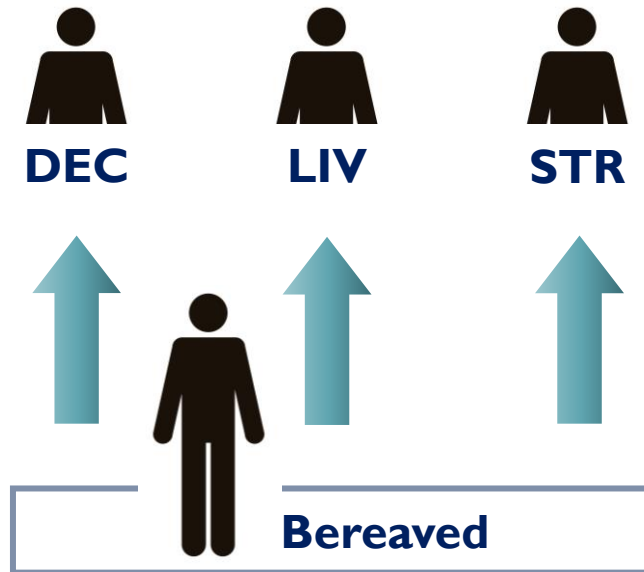


B. 2nd Canonical Dimension

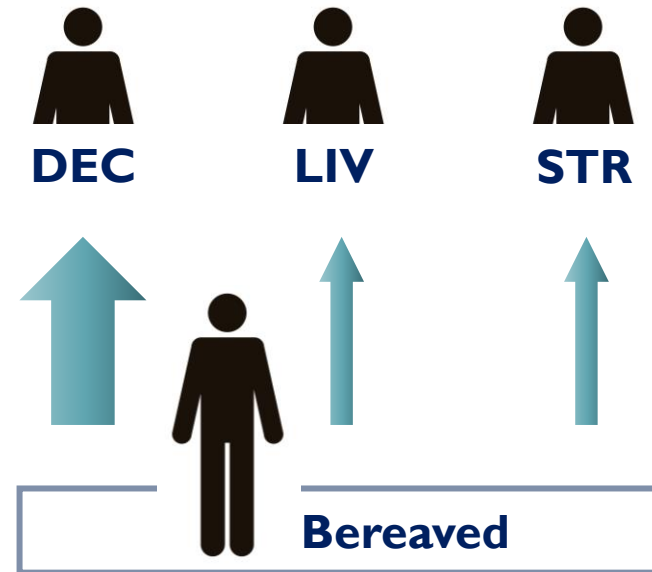


# Hypothesis: Prolonged Grief and Empathy Bias

## Integrated Grief



## Prolonged Grief



# Results supported the hypothesis

Prolonged grief symptoms were associated with...

- **Enhanced empathy for the deceased**

  - Continuing bonds with the deceased

    - Klass et al. *Continuing bonds: New understanding of grief*, 1996

  - Brain's reward system responsiveness to grief-related stimuli

    - O'Connor et al. *Neuroimage* 2008; Kakarala et al. *Psychiatry Res Neuroimaging* 2020

  - Increased oxytocin in CG?

    - Bui et al. *Eur J Psychotraumatol* 2019

  - Approach tendency to grief-related stimuli

    - MacCallum et al. *J Behav Ther Exp Psychiatry* 2015

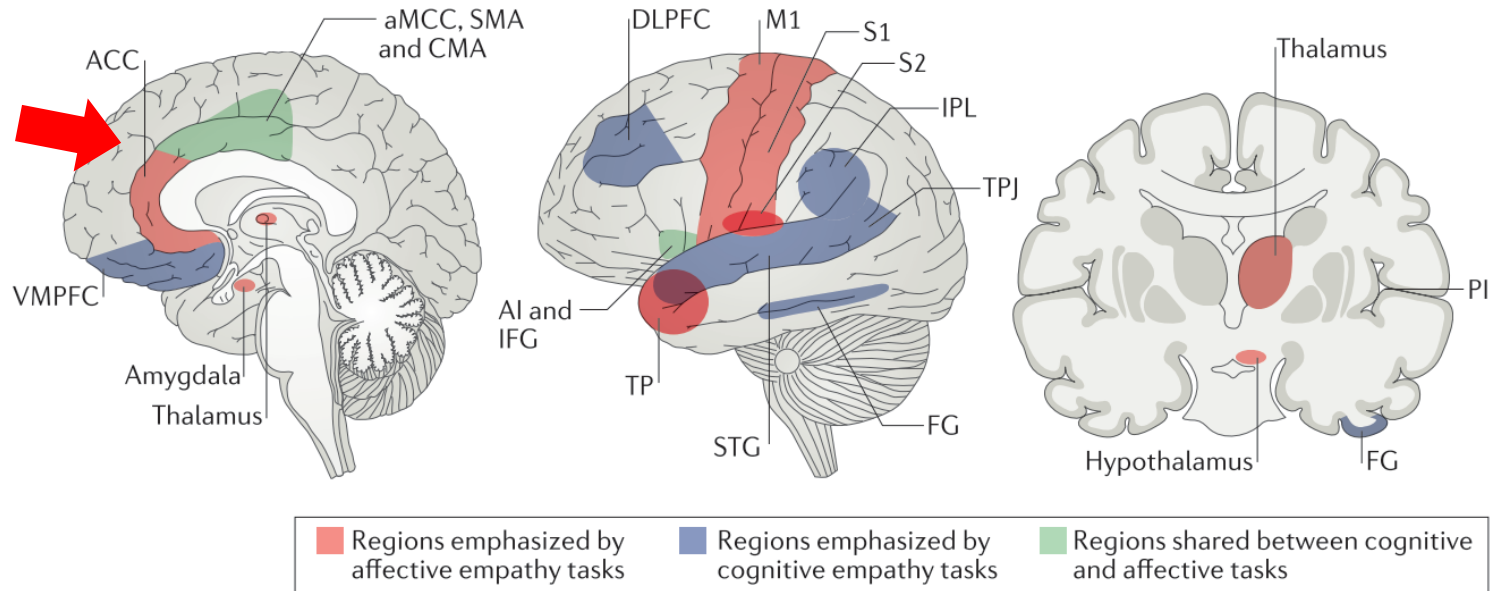
- **Diminished empathic brain activation for the living**

  - Potential difficulty maintaining or rebuilding social bonds after loss

  - An intervention target?



# dACC–aMCC–SMA: a core neural network in empathy



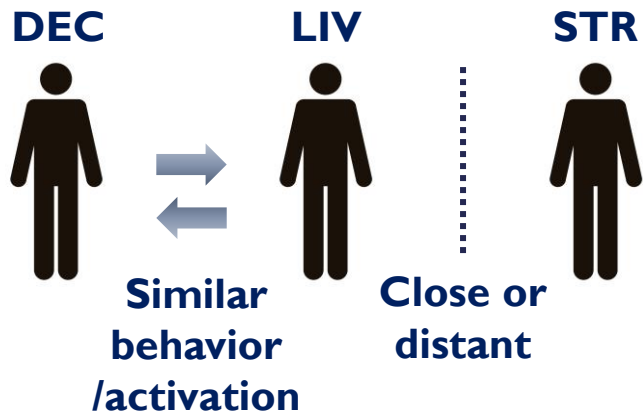
Waal & Preston *Nat Rev Neurosci* 2017

*What is the goal of our empathy for others' pain?  
Protection of conspecifics for survival?*

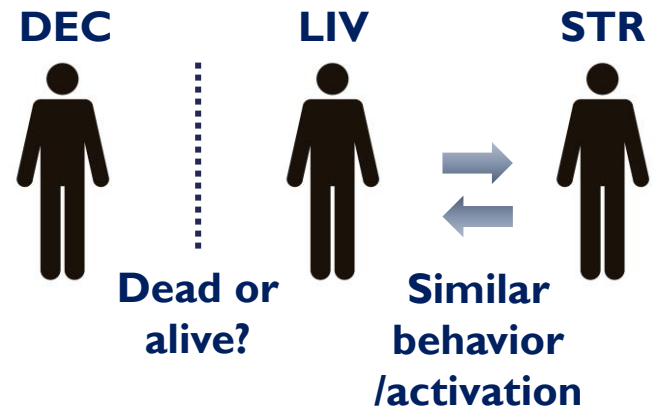
**Prolonged grief affects the empathic brain**

# Empathic brain distinguishes closeness or the dead/living in grief?

Closer relationship, greater empathy



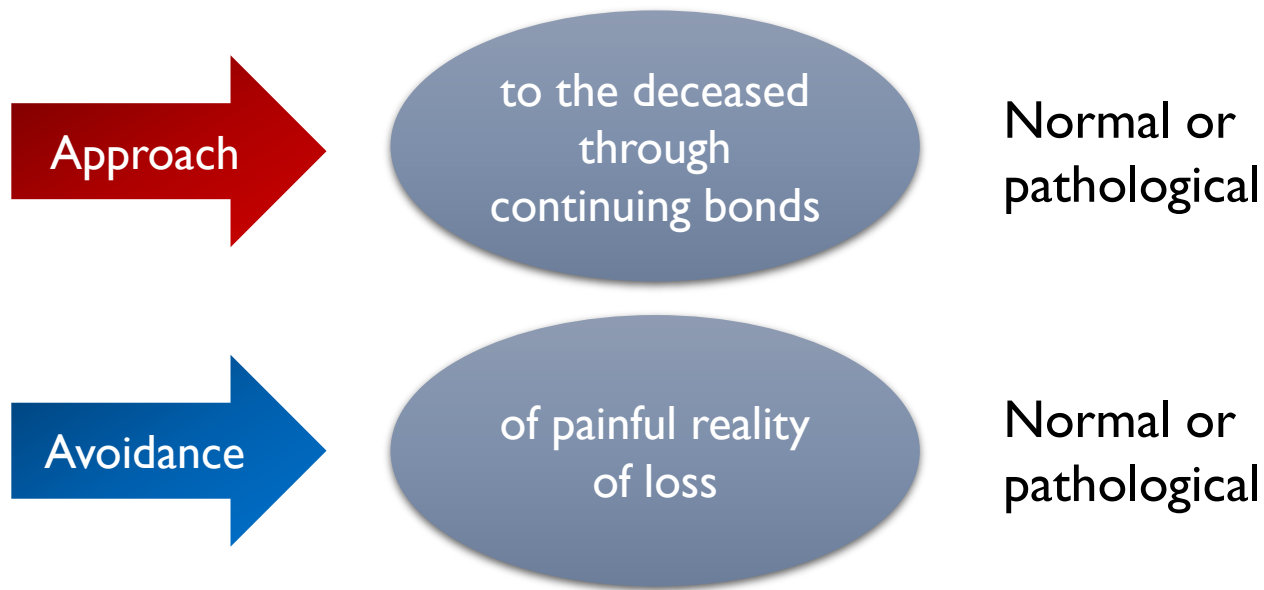
Feeling distant from LIV?



**Restructure of an empathic hierarchy after loss**

# Approach vs Avoidance

## Do their biological consequences differ?



- Avoidance facilitates adaptation to loss, when used judiciously and dynamically.
- But when over-used, it can become an encumbrance to mourning.

Shear et al. *Omega J Death Dying* 2010

**Does regaining loss reality reduce empathy bias,  
or vice versa?**

# Acknowledgements



At an art exhibition by bereaved families:

- *She composed a desk filled with books and ship models he liked and hung a white coat on the back of the chair, imagining her son, Masamune, as having become a medical student.*
- *She lost her 9-year-old son in a car accident in 2017. While he was alive, he wished to become a medical doctor who was able to cure his mother's rheumatoid arthritis.*

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The image features a large, dark silhouette of a geodesic dome structure, possibly a planetarium or observatory. Two people are silhouetted against the bright background, standing on a platform and looking out. The background shows a cityscape and a body of water under a clear sky. The overall color palette is monochromatic, with shades of blue and black.

**Thank you very much for your attention!**