

Phenotyping Animal Barbering and Grooming

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Definitions

Grooming:

An animal's cleaning and caring for the body surface. This includes preening, the cleaning and oiling hair with the tongue

Two forms of grooming

Hetero-grooming or “alogrooming”

- When an animal grooms another animal



Self-grooming or “autogrooming”

- When an animal grooms itself



Grooming

- Evolutionarily ancient behavior
- Second (after sleep) in represented behaviors
- in rodents up to 30-50% of their waking time
- Highly sensitive to stress
- Bidirectionally sensitive to many pharmaceutical compounds

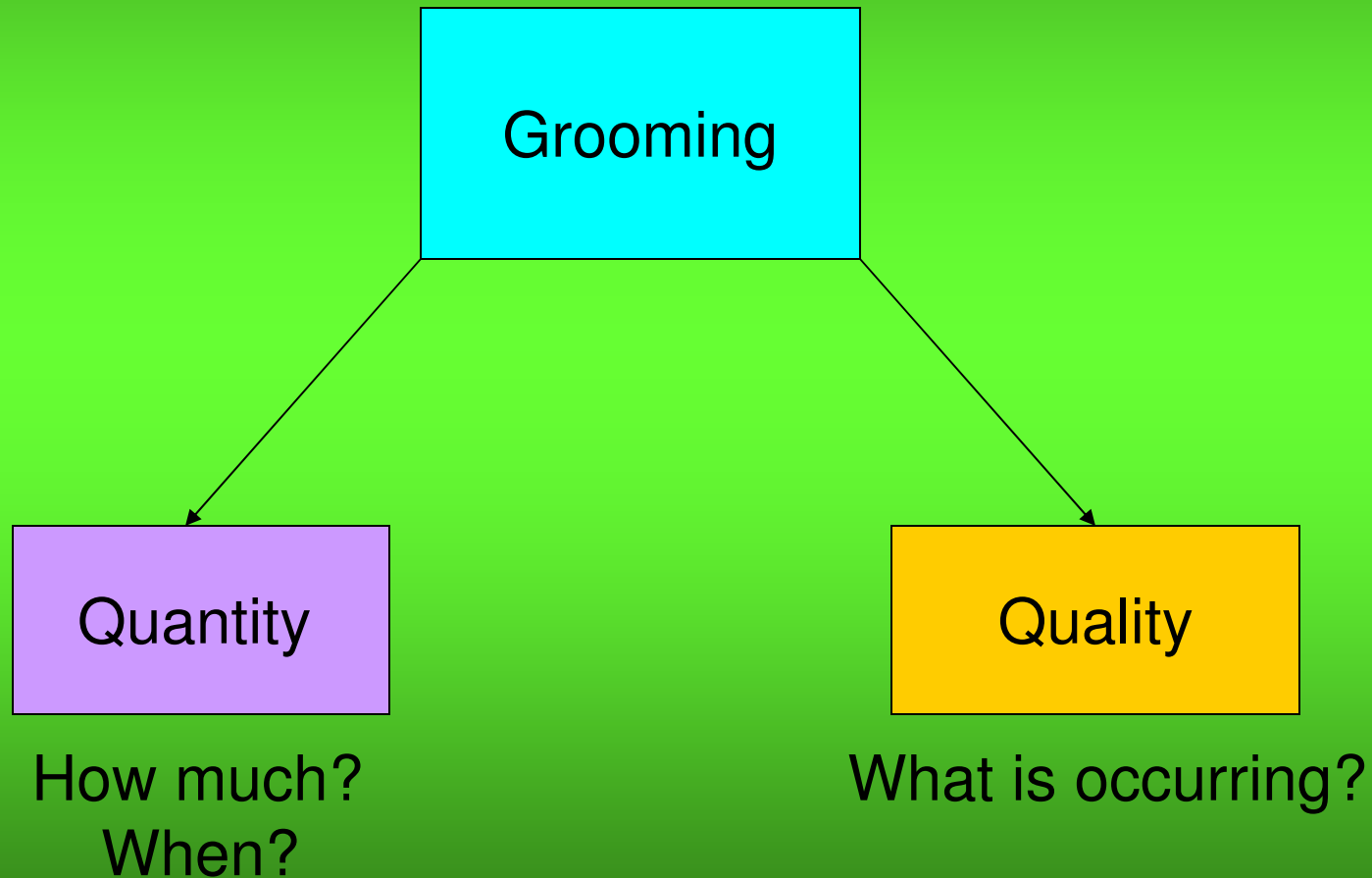
Grooming

- Has strong genetic component
- Sensitive to genetic manipulation
- Emerges as a very important behavioral endpoint for mental health research
- In many published studies, is often the only behavior affected

Biological functions of grooming

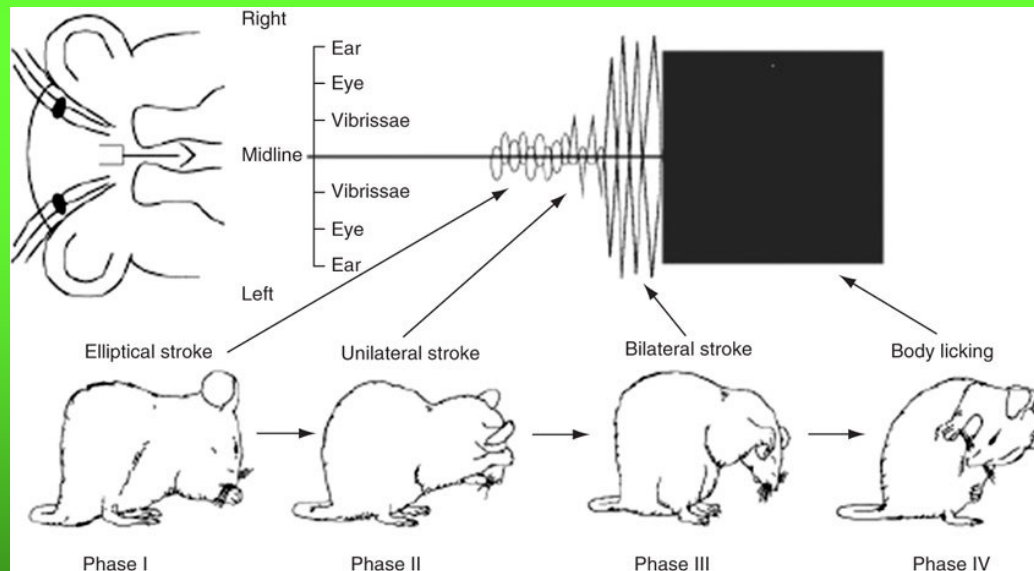
- Removing parasites
- Basic hygiene
- Thermoregulation
- Chemocommunication
- Distribution of pheromones over body surface
- Maternal care
- Establishing social hierarchy
- Displacement behavior
- Dearousal
- Social signaling (“I am not afraid”)

Two aspects of grooming



Patterned grooming: “quality”

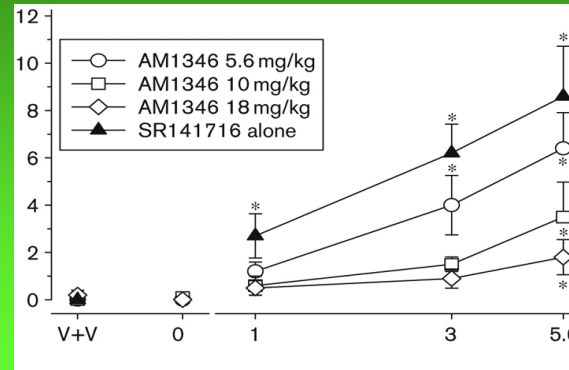
- Four distinct phases in sequential order
- Rodent cephalo-caudal pattern
- Includes more meaningful endpoints of grooming transitions, interruptions, completed sequences
- Sensitive to stress and pharmacological compounds



Elliptical stroke Unilateral stroke Bilateral stroke Body licking

Traditional endpoints: “quantity”

- Number of bouts (frequency)



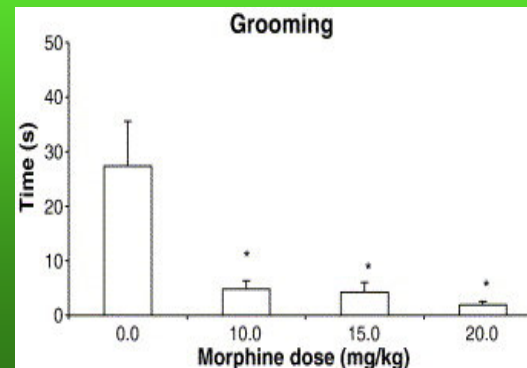
Jarbe et al., 2007

- Latency to begin (s)



Spencer et al., 2006

- Duration (s)



Patti et al., 2005

“Quality” of grooming

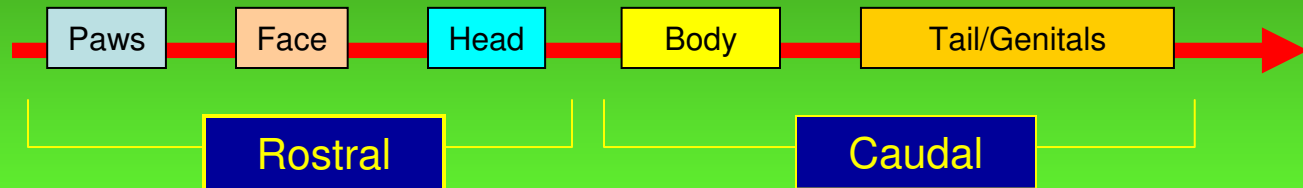
- How performed?
- What stages?
- Transition between stages?
- Regional distribution?
- Interrupted/ incomplete bouts?

Two approaches to grooming qualitative analysis

- Grooming Analysis Algorithm (GAA) (Kalueff et al., 2004). Examines grooming behavior globally
- Syntactic Chain (Berridge et al., 1987). Examines only selected types of grooming behavior, but more specifically

Video clip 1
Video clip 2
Video clip 3

Grooming Analysis Algorithm (GAA)



Gross activity scores:

Frequently unaltered, or change unpredictably

Is not stress: can be increased by anxiolytics

Importance of
alternative
approaches

Grooming patterning (GAA): Kalueff, 2001



- Transitions
- Interruptions
- % completed sequences
- regional distribution

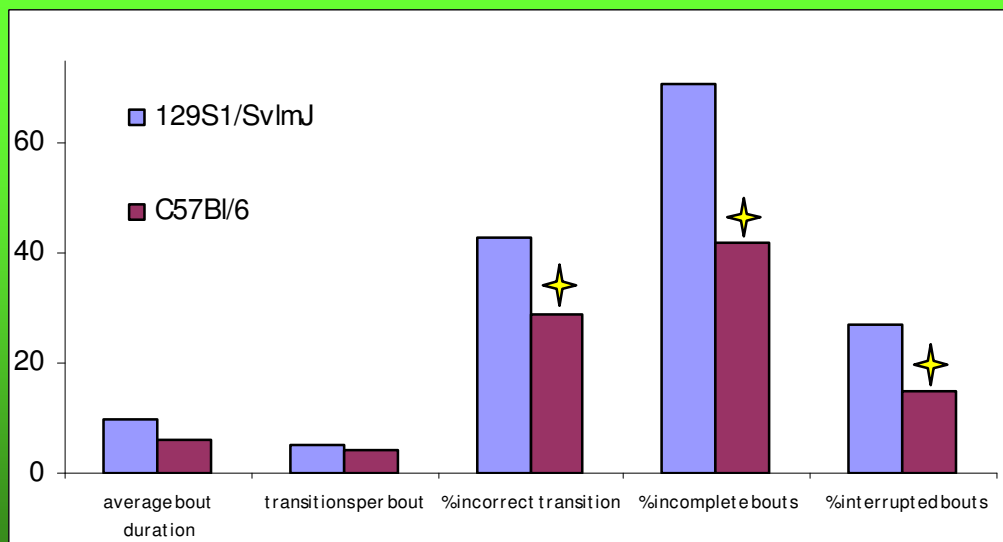
GAA

Stress disrupts behavioral organization of grooming:

- ↓ correct transitions, ↓ completed sequences,
- ↑ interrupted bouts, ↑ rostral grooming, ↓ caudal grooming

Grooming Analysis Algorithm (GAA)

- Patterning – Whether or not the grooming continues in the cephalo-caudal progression
- Interruptions – Is the grooming cycle interrupted?



Kalueff et al., 2004

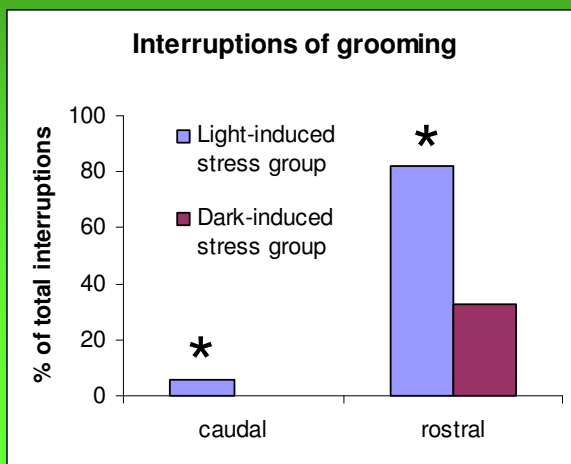
GAA Protocol

- 1) Transfer rodents to the procedure room for acclimation 1 hr before testing
- 2) Remove the rodent from the cage and expose it to a stress that will induce grooming
- 3) Use a timer to record general cumulative measures of grooming activity, such as the latency to onset, the duration and number of grooming episodes (bouts)

GAA Protocol

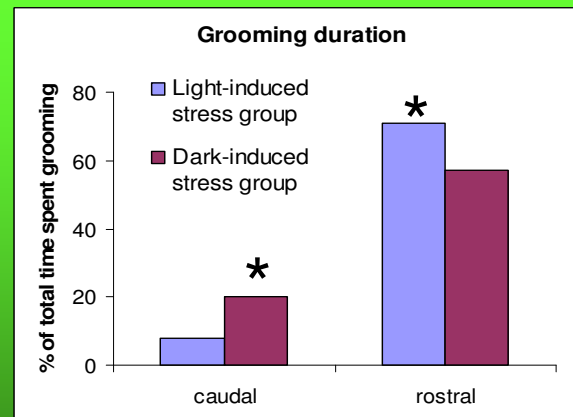
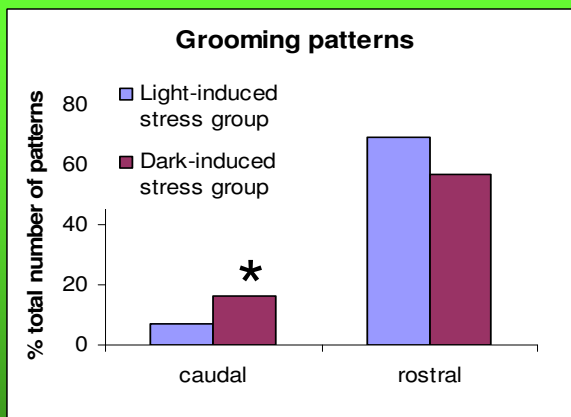
- 4) Record grooming patterns for each bout:
 - paw licking
 - nose/face grooming (strokes along the snout)
 - head washing
 - body and leg grooming/scratching
 - tail/genitals grooming (licking genital area and tail)
- 5) Assess the total number of transitions between grooming stages and the average number of transitions per bout

Regional distribution of grooming



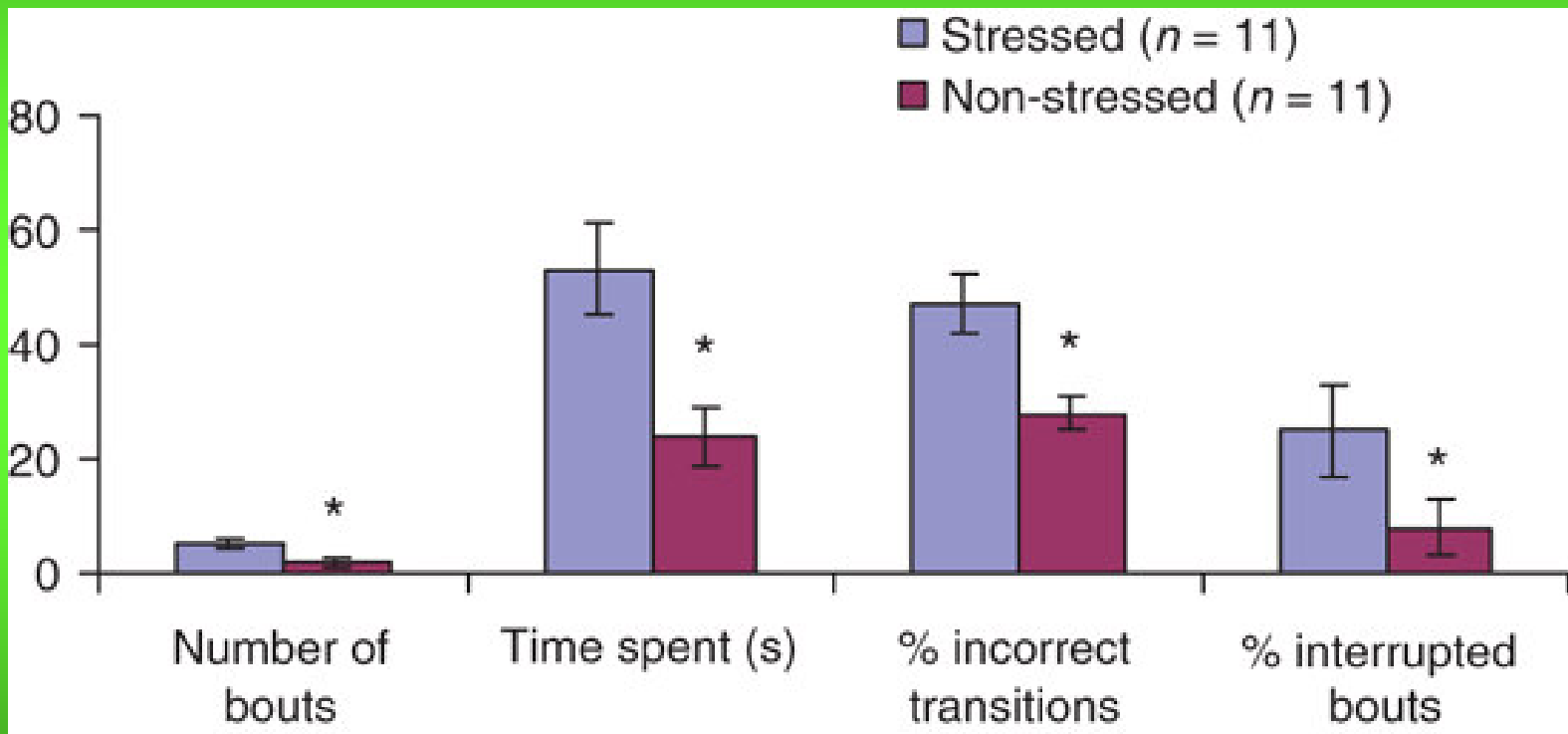
Q: Where?

Example: High vs. low stress Wistar rats

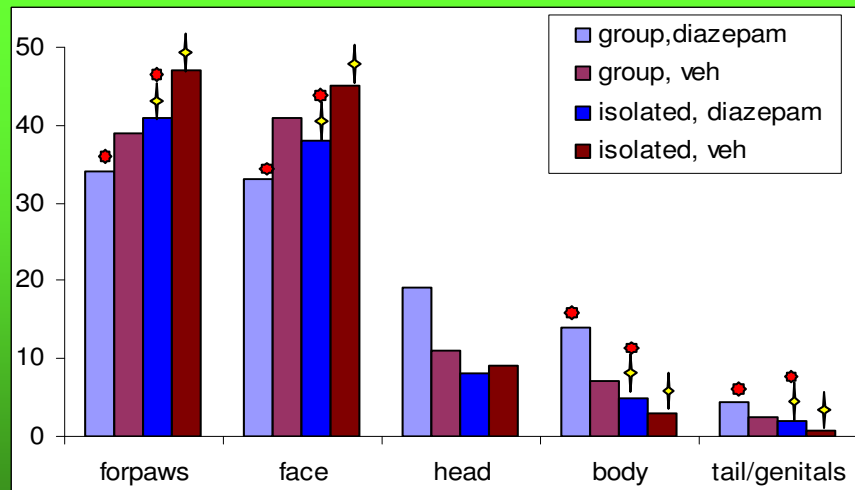
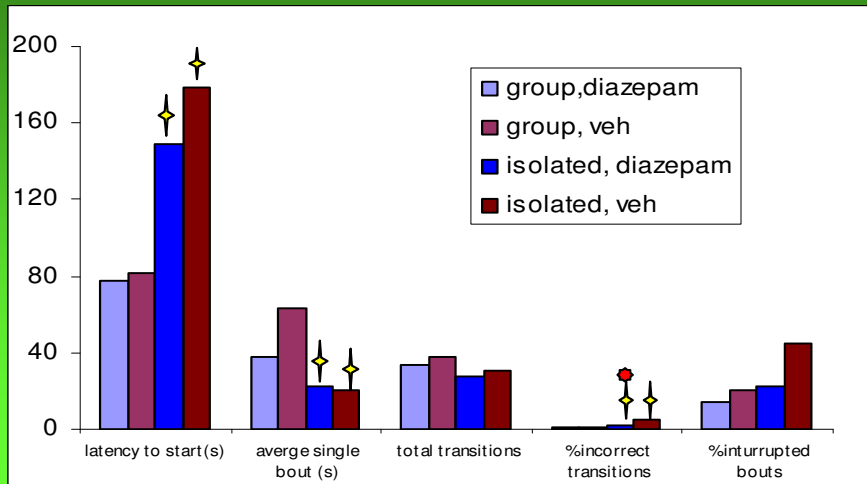


Kalueff et al., 2005

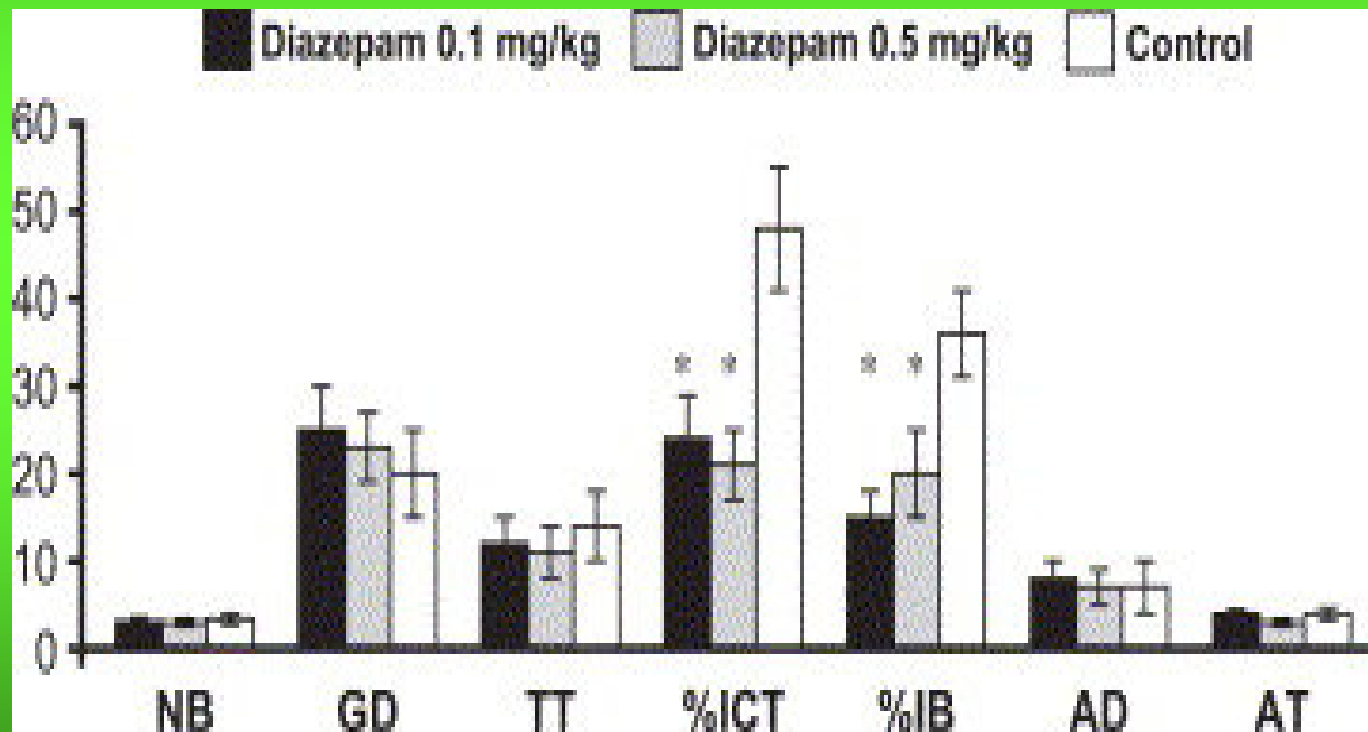
Psychological stress disrupts patterning



Drugs modulate patterning in rats



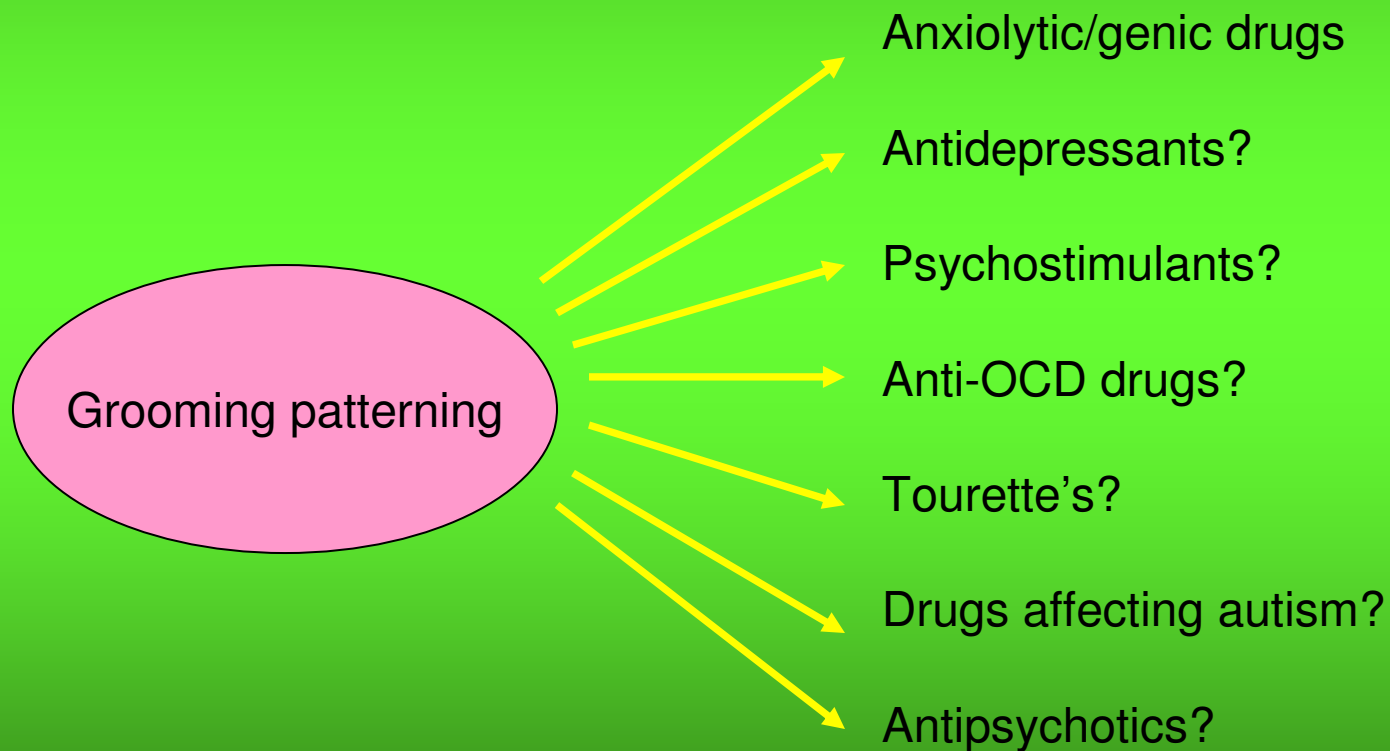
Drugs modulate patterning in mice



Enginar et al. (2008): Evaluation of the acute effects of amitriptyline and fluoxetine on anxiety using the grooming analysis algorithm in rats. *Pharmacol Biochem Behav.*

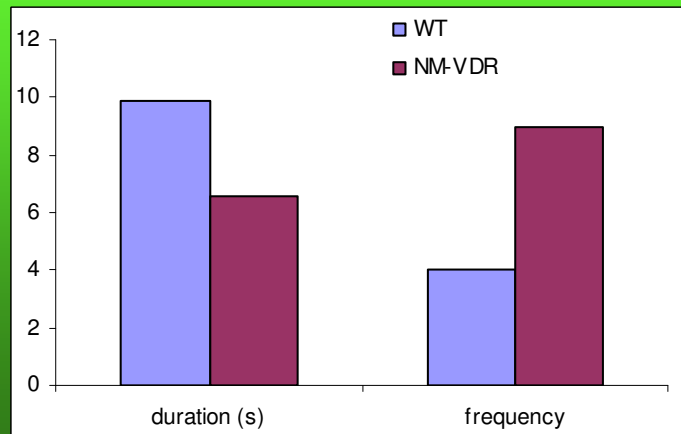
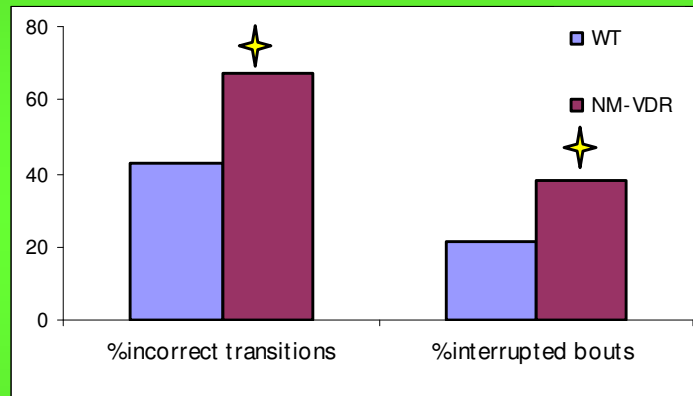
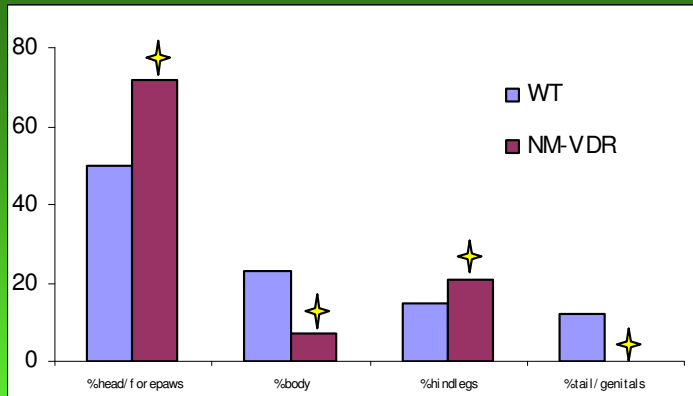
Audet et al. (2006): Subchronic Phencyclidin disorganized grooming sequences in rats, but only under “stress” conditions. The examination of grooming organization is a tool to measure stress-induced behavioral sensitization and motor functions in animal models of schizophrenia.

Developing utility of grooming analysis for drug design and discovery



Genetic mutations

e.g. VDR KO (129S1 background strain)



↑ % of "incorrect" transitions and duration of "incorrect" grooming, interrupted bouts

↑ leg grooming, ↓ body and tail/genital grooming (graphs feature novelty-induced grooming)

Kalueff et al., 2005

Syntax grooming

- 1) Handle the animals and put them in the recording chamber for a short period of time (10–30 min) 3–4 d before study, for acclimation to the testing environment and filming procedures
- 2) Remove the rodent from the cage and transfer it to the recording chamber
- 3) Place the rodent in a recording chamber with a clear plastic floor and a video camera to record from below
- 4) Use a frame-by-frame offline analysis of the videotapes, using both a choreographic notation system developed for detailed descriptions of stereotyped grooming sequences

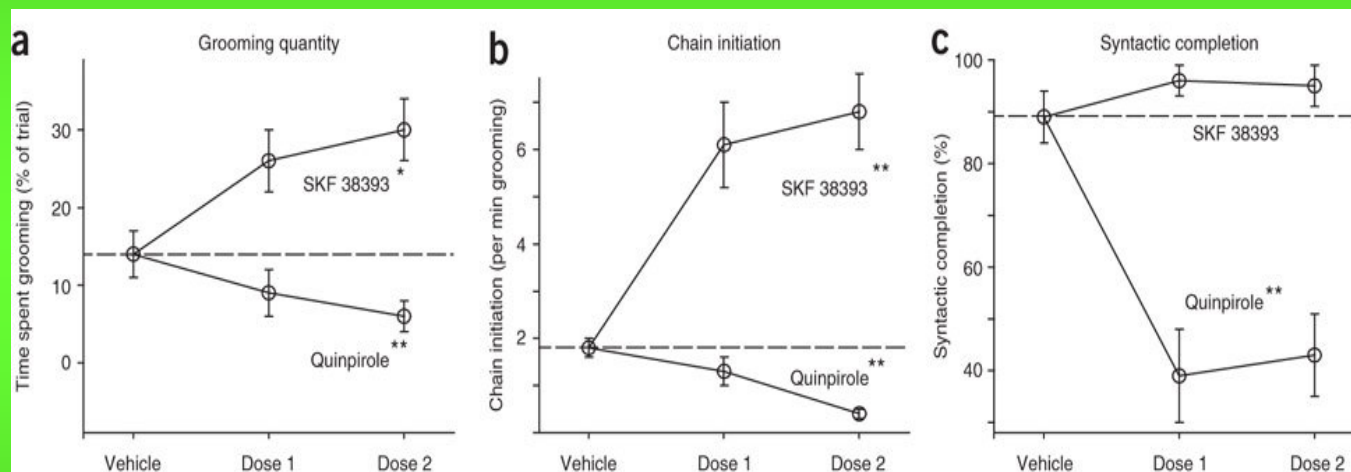
Syntax grooming

5) Assess the number of:

- initiated syntactic chains
- the number of fully completed chains (through phase IV)
- the probability of chain initiation (the number of initiated syntactic chains per minute of grooming time)
- the probability of pattern completion once initiated (the percentage of fully completed grooming chains of total number of initiated chains)

A different approach: syntactic chain analysis

Effects of D1 (SKF 38393) and D2 (quinpirole) agonists

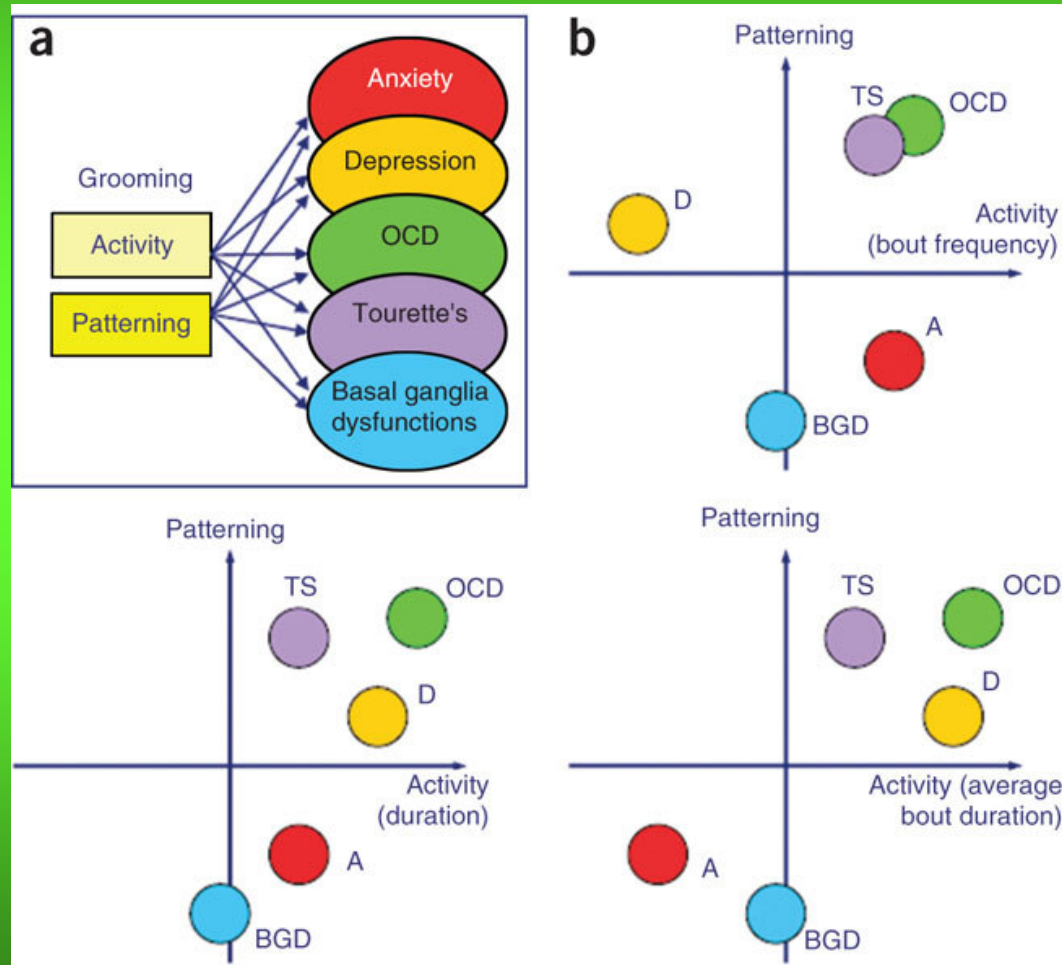


- (a) Amount of grooming as a percentage of total time
- (b) Syntactic chain initiation
- (c) Syntactic completion

Dose 1: SKF 38393 = 10 mg/kg, quinpirole = 5 mg/kg
Dose 2: SKF 38393 = 20 mg/kg, quinpirole = 10 mg/kg

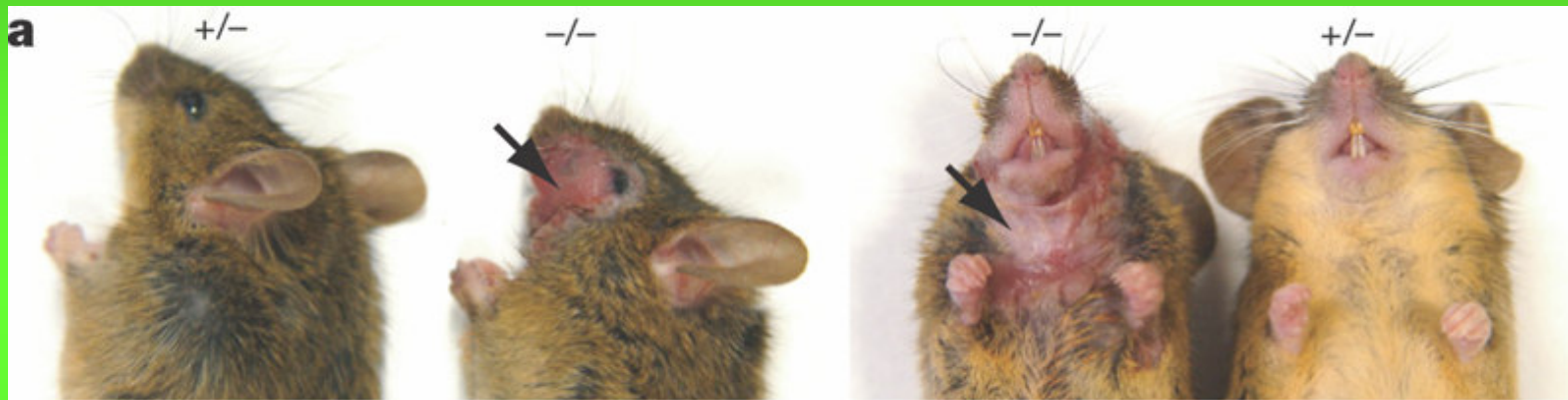
Berridge and Aldridge, 2000

Relevance of grooming parameters to modeling human brain disorders



Genetic models: relevance to OCD

Increased grooming in SAPAP3^{-/-} mice



Welch et al., 2007

Other OCD/grooming models:

- BTBR mice: Yang et al. 2007
- Hox8^{-/-} mice: Greer and Capecchi, 2002

Barbering



Wurbel and Garner, 2007

Barbering: The removal or trimming of an animal's hair or whiskers by a conspecific

Two forms:

- 1) self-barbering
- 2) hetero-barbering

Barbering

- Behavior-associated hair loss
- A complex behavior
- Hair trimming or plucking
- Frequent in laboratory rodents
- Has several distinct contexts
- Has strong genetic component
- Common in some mouse strains
- Sensitive to various manipulations: stress, aggression
- Represents a useful index in behavioral research



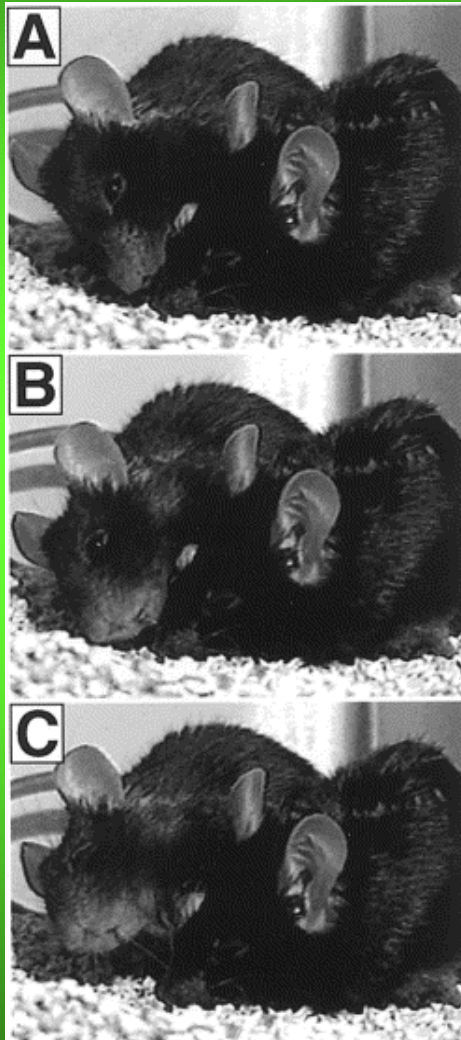
thefunmouse.com

Normal whiskers

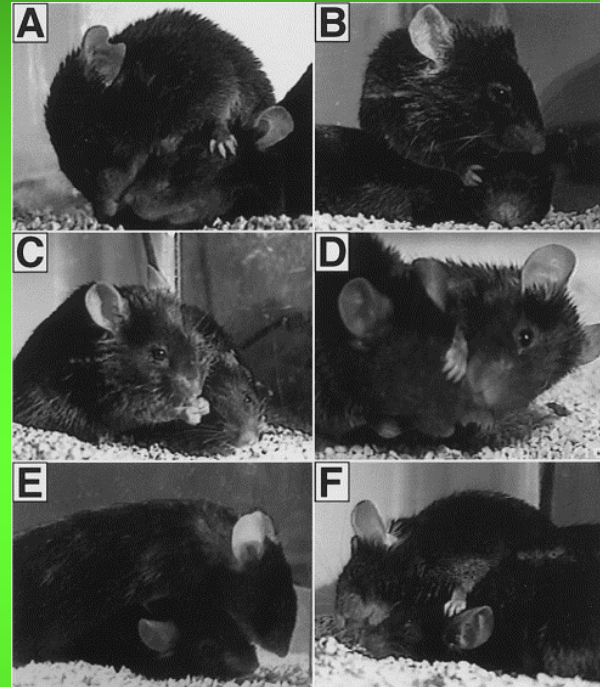
- Whiskers (importance for senses and balance) are chewed off by conspecifics
- Commonly done by the dominant mouse
- ↑ social barbering usually results in ↓ fighting
- Every animal in cage may participate in barbering
- Socially transmitted (can be evoked in non-barbering cages)



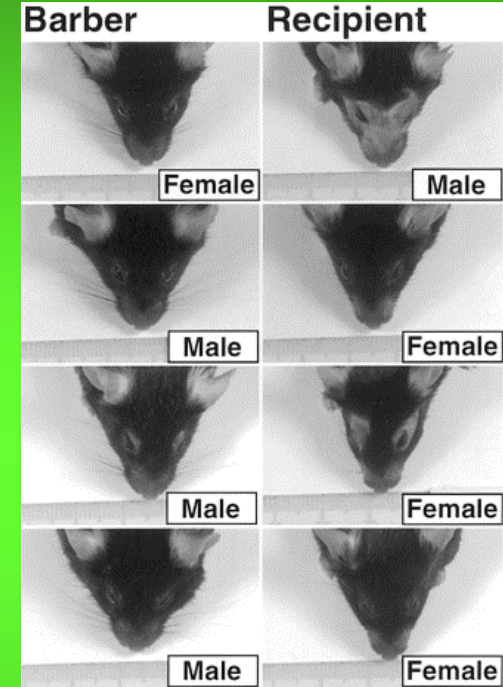
Barbering: How?



A typical barbering act

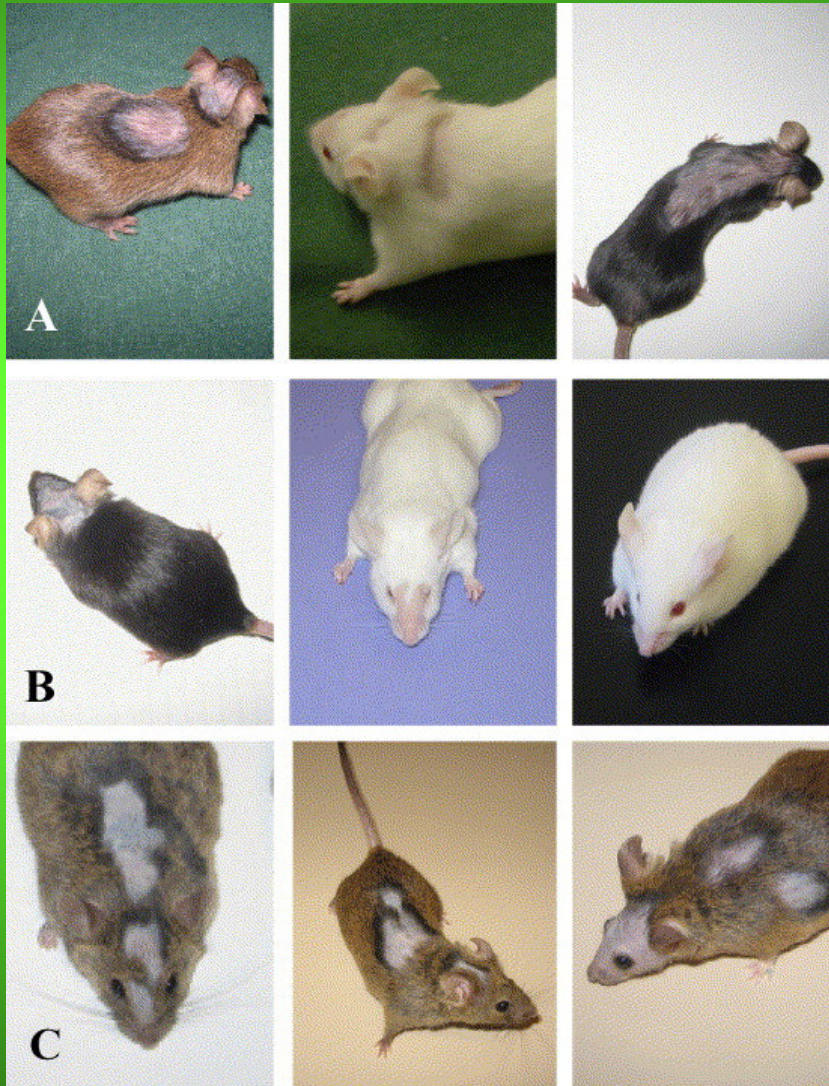


Barbering postures:
plucking and trimming



Examples of
facial barbering

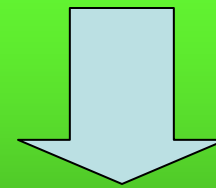
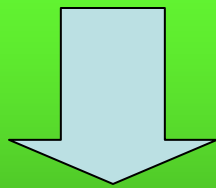
Mouse strain differences



- (A) Sexual barbering by female barbers, left to right: 129S1, NMRI, C57Bl/6 males.
- (B) Social (dominant) barbering in same-sex cages, left to right: C57Bl/6 females, NMRI females;
- (C) Barbering in male mice of F1 hybrid strains, left to right: NMRI-129S1, C57Bl/6-129S1, C57Bl/6-129SvJ mice

Genetic nature of barbering

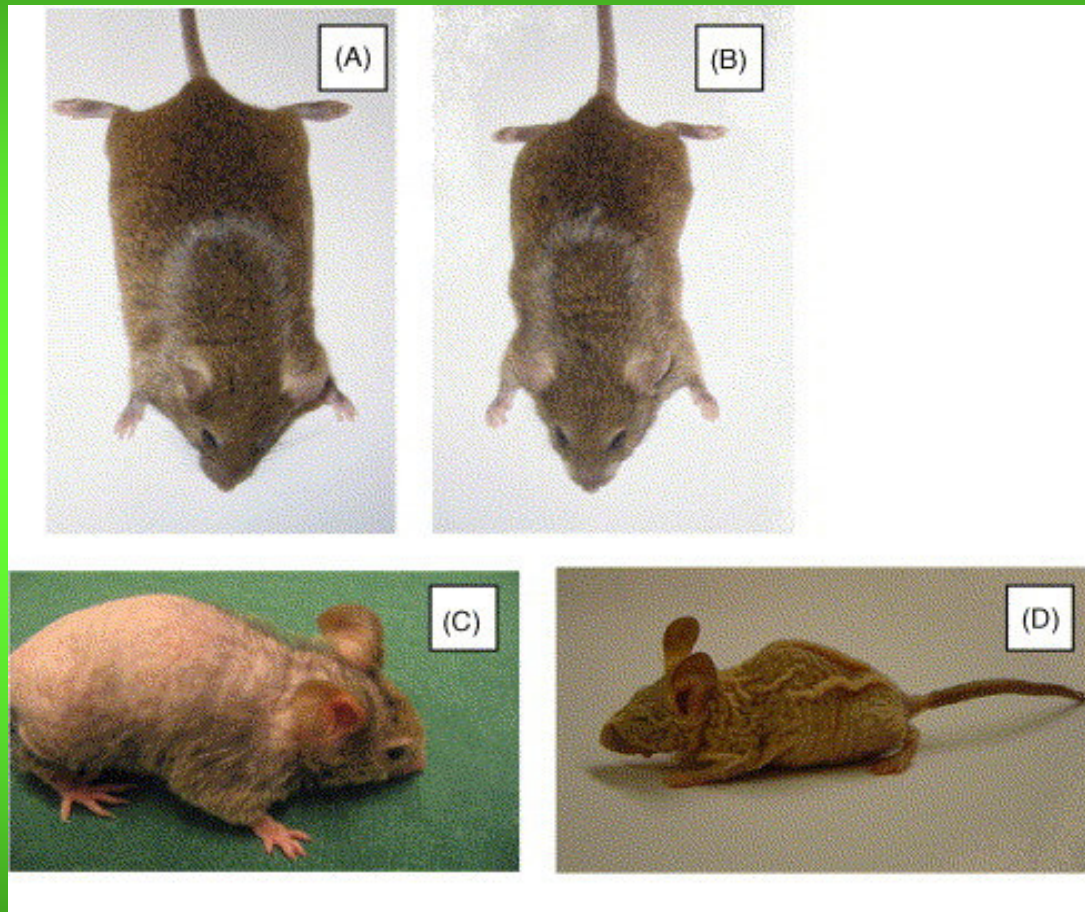
Balb/c	F1 Balb/c x C57	C57
Aggressive	Aggressive	Not aggressive
No barbering	No barbering	Active barbering



Balb/c “no barbering” genes expressed >> “Barbering” genotype of C57
(Balb/c has stronger genetic effect)

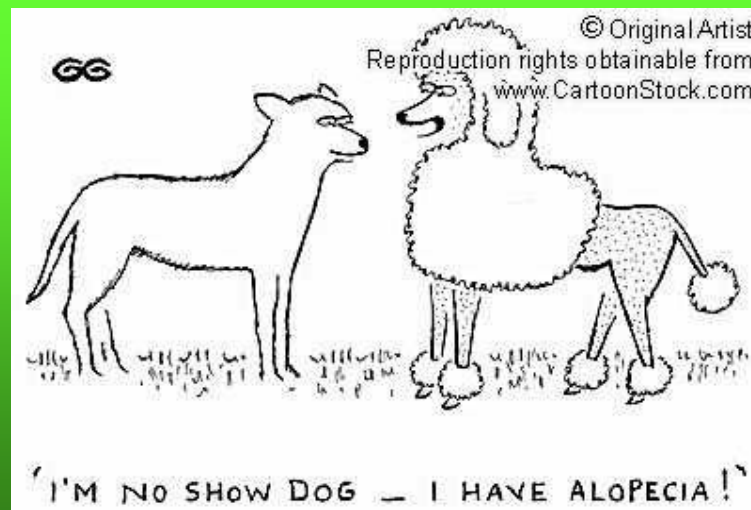
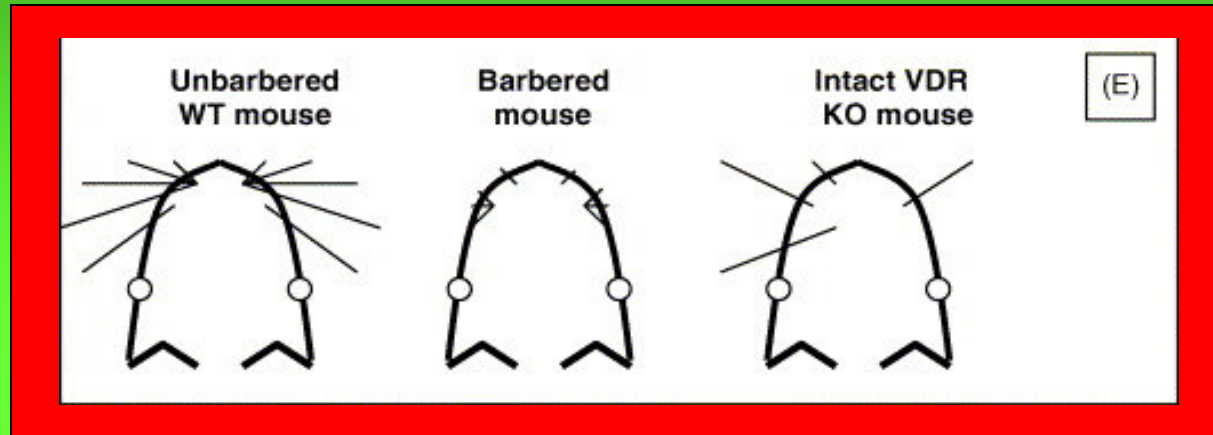
Abnormally low barbering

Example: VDR KO mice



- (A) WT 129S1 mouse with normal fur and whiskers
- (B) Barbered WT mouse without whiskers.
- (C) Intact 4-month old VDR KO mouse, with pronounced progressing alopecia
- (D) Nude 1-year old VDR KO mouse, with no fur and whiskers

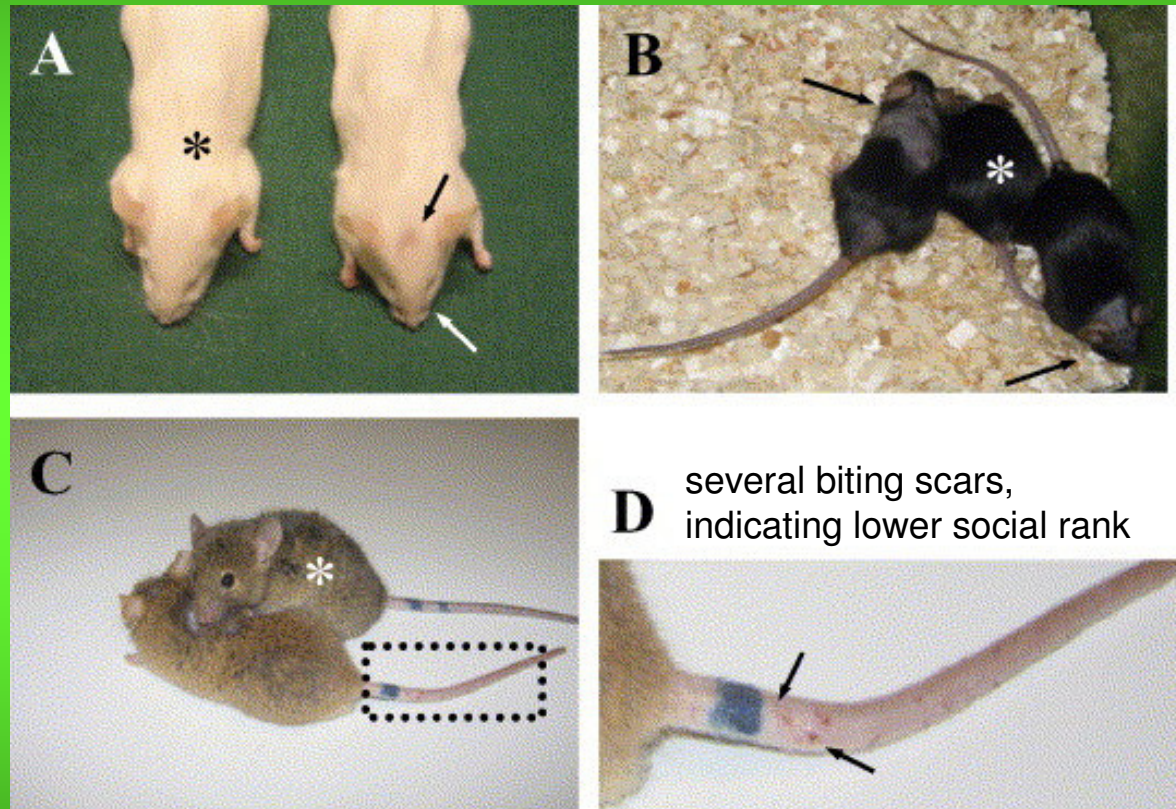
Alopecia vs. and barbering-evoked whisker loss



Kalueff et al., 2005

Social/dominant barbering

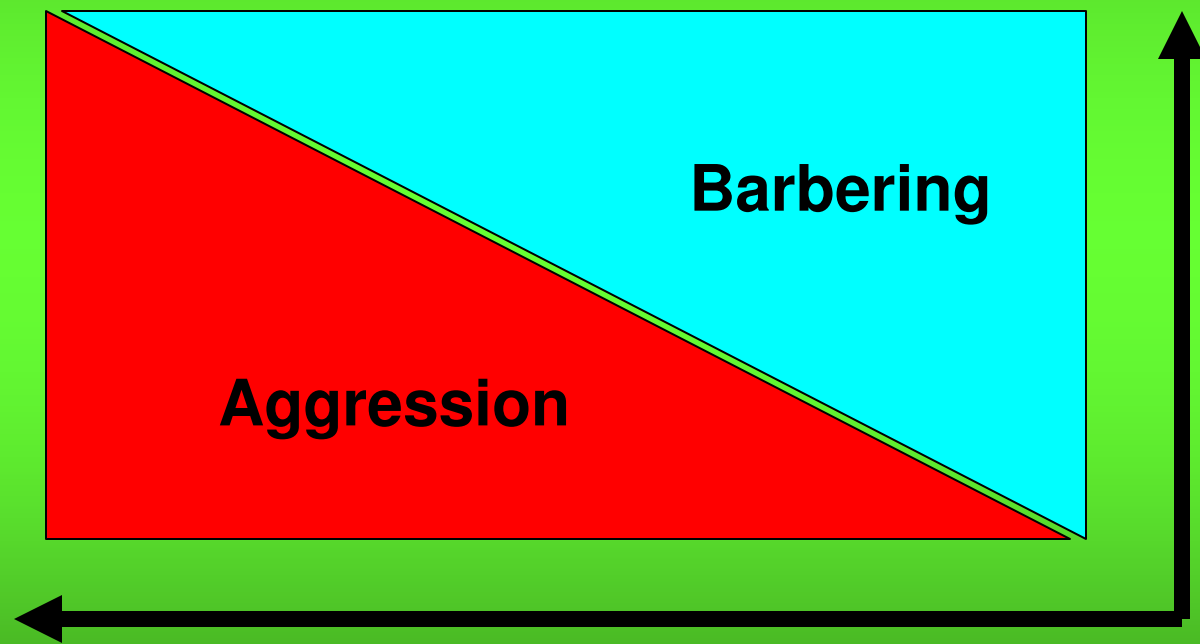
(* = dominant barber)



(A) NMRI mice. (B) C57Bl/6 mice. (C) Barbering in two F1 C57Bl/6–129S1 mice

Kalueff et al., 2006

Aggression and barbering



Sexual barbering

- Usually performed by females
- Males undergo this barbering willingly
- Some males may also groom females as well



Figure 1.

Photo;
Deluca,
1997



A very human behavior?

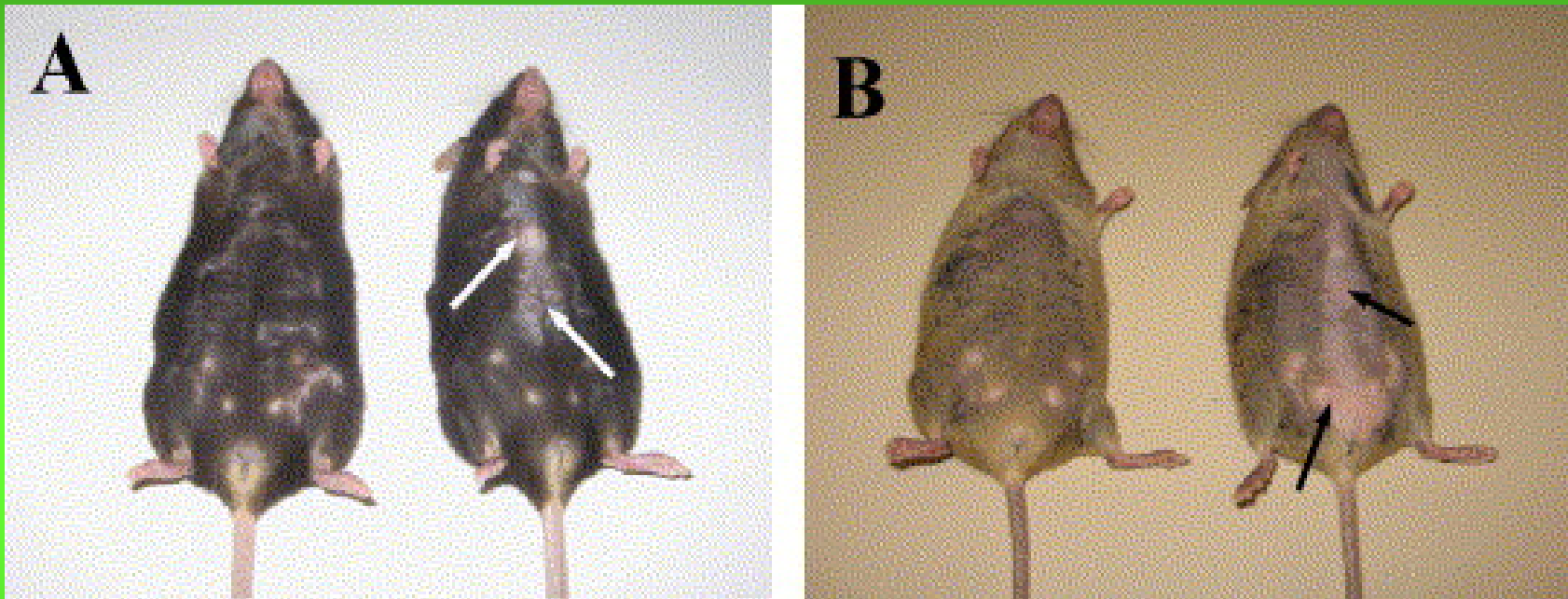
Applicability to human behavior?



Applicability to human behavior?



“Maternal” barbering



Produced by suckling pups in lactating mice of C57BL/6 (A) and 129S1 (B) strains, photographed immediately after weaning

Summary

- It is important to assess of grooming and barbering phenotypes in neurobehavioral research in animals
- New techniques and acquisition methods are needed (e.g. 24-hr monitoring systems able to recognize grooming and barbering)
- Applicability for translational research in humans
- Particular relevance for neuropsychiatric disorders (OCD, Trichotillomania, aggression, etc.)

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"Son, our cat has a condition called
'Excessive Grooming Syndrome.'
Too bad it isn't contagious."