

# Behavioural Needs/ Environmental Enrichment

Euprim Net  
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- What is Environmental Enrichment?
- Wild activity budgets
- Normal and Abnormal Behaviours

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## What is environmental enrichment?

Yerkes (1925) "The greatest possibility for improvement in our provision for captive primates lies with the invention and installation of apparatus, which can be used for play or work" (cited in Shepherdson 1998, p. 7).

- The Enrichment Working Group of the Behavior and Husbandry Advisory Group, a scientific advisory group of the American Zoo and Aquarium Association, defines enrichment as "a dynamic process in which changes to structures and husbandry practices are made with the goal of increasing behavioral choices available to animals and drawing out their species-appropriate behaviors and abilities, thus enhancing animal welfare" (BHAG 1999, p. 2).

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### Not just behaviour...

- Newberry (1995) describes enrichment as an “improvement in the **biological** functioning of captive animals resulting from modifications to their environment” (p. 230).
- Shepherdson (1998) “An animal husbandry principle that seeks to enhance the quality of captive animal care by identifying and providing the environmental stimuli necessary for optimal **psychological** and **physiological** well-being”

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### How to assess if needs are met - criteria similar to goals of enrichment

- absence of abnormal
- if individual has wide repertoire of behaviour
- is animal is confident (moves freely with no fear or aversive behaviour)
- if able to rest in a relaxed manner (not constantly vigilant)

From Poole, 1998

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### Goals of EE

- Increase diversity and performance of **normal** (wild, desired) behaviours
- Increase behavioural choices
- **Prevent** abnormal behaviour developing (Reduce the frequencies of abnormal behaviours) **PROACTIVE NOT REACTIVE**
- Increase positive utilisation of the environment
- Increase ability to cope with challenges in a more normal way

(adapted from various sources)

Any others?

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## Goals

- Increase diversity and performance of normal (wild, desired) behaviours
- Increase behavioural choices
- Prevent abnormal behaviour developing (Reduce the frequencies of abnormal behaviours)
- Increase positive utilisation of the environment
- Increase ability to cope with challenges in a more normal way
- **Stimulate and challenge**

- May not all be achievable simultaneously
- May not all be easy to measure
- The means of achieving the goals (crocodiles, food on floor)
- What is normal?




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## DISCUSSION - What is normal?

For your study species, estimate what you consider to be normal for:

- Foraging/feeding (% of waking time)
- Moving (% of waking time)
- Grooming/social (when in social gp. - % of waking time)
- Sleeping (no. of hrs/24)
- Scent marking (rate per hour – marmosets only)

Do separately for **WILD** and **CAPTIVE**

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## The activity budget of wild common marmosets (percentages of time)

Captive

	Stevenson & Rylands, 1988	Alonso & Langguth, 1989	Ferrari & Digby, 1996
Moving	35% (including foraging)	11%	20%
Foraging		24%	< 1%
Feeding	10%	27%	
Stationary (resting)	53%	18%	
Social activities	10%	15% (grooming)	2%
Resting+ socializing			37%
Interactions with other groups		5%	Inactive alert 68% (Bachin)

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### The activity budget of wild tamarins (percentages of time)

	Saddleback Soini, 1983	Saddleback Terborgh, 1983	Emperor Terborgh, 1983	Captive Red bellies (B-S)
Insect forage	45	16	34	20% locomote
Travel	6	20	21	
Forage and travel	51	36	55	
Fruit feed	15	16	17	68%
rest	31	44	25	
other	3	4	3	
				3% groom

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### The activity budget of wild Indian Rhesus macaques in different habitats (percentages of time – Seth et al.)

Habitat	Feeding	Locomotion	Resting	Grooming	Play	Others
Temple	26.74	15.75	36.70	12.38	6.20	2.23
Urban	21.92	19.32	36.72	1.78	7.87	2.39
Pond	28.00	11.17	39.35	8.48	11.98	1.02
Roadside	31.26	14.28	34.66	9.80	9.55	0.45
Canal side	25.00	19.84	40.03	5.93	7.10	2.10
Forest	33.60	24.14	35.08	2.15	3.49	1.54

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### Scent-marking in marmosets




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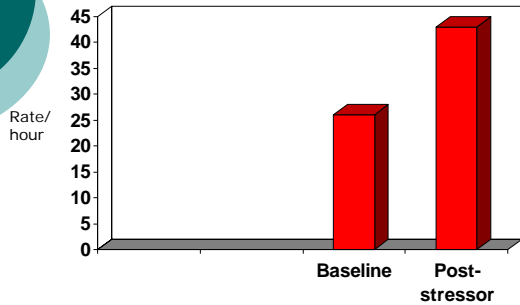
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Mean rates of scent-marking/hour, pre- and post-stressor in common marmosets



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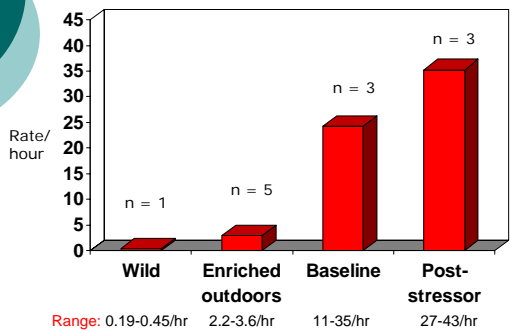
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Mean rates of scent-marking/hour in four different environmental situations in common marmosets.



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### Why is wild behaviour appropriate

- Understanding of how the animal is adapted (locomotion, foraging type, processing etc), breeding, hiding from threats/predators, interacting with conspecifics etc)
- Always find out about your animal
- Try to see them in wild!

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### Why can't we just simply compare captive primates' behaviour to wild primates?

1. Activity budgets of wild primates may be biased due to observational difficulties
2. Generalising wild primate behaviour from a geographic or temporal location to all members of the species is problematic
3. Obtaining adequate samples in wild is rare
4. Captive and wild populations are often significantly different genetically [more...](#)

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### Why can't we just simply compare captive primates behaviour to wild primates?

5. Observations of captive and wild populations are often made by different researchers, which may introduce questions of validity.
6. Approach assumes that wild animals have sufficient welfare.
7. Captive animals adapt to their environment, but this behavioural change is not necessarily indicative of decreased welfare.

(adapted from Veasey et al (1996) and Shepherdson (1998))

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### Natural and Unnatural

What constitutes 'normal' and 'abnormal' behaviour - different for captive and wild animals due to environmental conditions (Erwin & Deni, 1979).

'Natural' behaviour has been defined as a behaviour that is "typically observed in the wild; it is adaptive in the evolutionary sense..(i.e.) has evolved by natural selection which allows an individual to survive more easily in its particular environment and so gives it a better chance of leaving offspring than an animal not so adapted (Poole, 1988b, p. 3).

'Unnatural' behaviour is defined as a behaviour that is not "seen in the wild. Not all unnatural behaviours are regarded as abnormal, however, as they may promote success within the captive environment" (Poole, 1988b, p. 3-4).

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## Normal and Abnormal

'Normal' behaviour will "promote the success and survival of the individual and its genetic contribution to the population" and is "clearly appropriate to the particular situation". It may also "be either natural or unnatural" (Poole, 1988b, p. 4).

'Abnormal' behaviour is defined as a behaviour that is 'rarely seen in wild populations and does not promote the success and the survival of the individual or its close relatives (i.e. it does not increase fitness). It appears not to be goal-oriented, so that its function is not apparent'. It 'may include elements of normal activities, but they are performed in an inappropriate fashion' (Poole, 1988b, p. 4).

Varies with species, age and sex differences as well as temperament and prior experience.

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## Typical abnormal behaviours

**Postural stereotypy** (e.g. saluting, floating limb, head tossing, rocking)

**Locomotor stereotypy** (e.g. excessive pacing, weaving, circling, somersaulting)

**Urine drinking**

**Consumption of faeces** (coprophagy)

**Teeth clenching or grinding** (bruxism)

**Stereotypy:** The performance of unusual motor acts, repeatedly and often invariably, which serve no apparent purpose; often indicative of an inadequate or inappropriate environment.

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## Other abnormal

- A restricted behavioural repertoire
  - Failure to make full use of the environment
  - Cessation of foraging or locomotion
  - Little curiosity towards novel objects
  - Little or no vocalisation
- An abnormal time budget
  - Restlessness or hyperactivity (e.g. circling)
  - Decreased activity (lethargy)
  - General inactivity or unresponsiveness
  - Excessive eating (hyperphagia)
  - Psychogenic excessive water drinking (polydipsia)
  - Increased scent marking
  - Inappropriate social behaviour
  - Increased aggression to conspecifics
  - Excessive fear towards or withdrawal from conspecifics (e.g. hiding at the back of the enclosure, hiding within or behind enclosure furniture)
  - Over grooming, or hair plucking of conspecifics leading to hair loss
  - Failure to mate
  - Killing or neglect of young
  - Change in behaviour towards human handlers (e.g. increased aggression or withdrawal)
  - Change in the behaviour of cage mates towards the individual animal

(Source JWGR, 2007)

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How many of you have animals behaving abnormally?  
(type, percent, why?)

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### Strategies to avoid abnormal behaviours developing

- Housing animals in socially harmonious groups or pairs and monitoring pair/group stability.
- Weaning animals before an appropriate age and level of development and into appropriate social groups.
- Providing a varied and stimulating physical environment with good environmental enrichment
- Providing an adequate and varied diet to stimulate natural foraging behaviour
- Providing animals with appropriate habituation to environmental stimuli and training
- Ensuring sympathetic and positive human-primate interactions

(Source JWGR, 2007)

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Housing systems primarily designed for hygienic, economic and ergonomic requirements.

Can primates behave "normally" in cages like this?

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○ Approaches to enrichment  
○ Why do EE  
○ Evidence that EE works

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**Approaches to Enrichment**

○ Naturalistic – creating wild environment in captivity to provide natural stimulation  
○ Behavioural Engineering – providing devices and machines that animals can operate to receive a reward (usually food)

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## Forest living



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## Behavioural engineering



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## Historical perspective

- Early 1900's – naturalistic enclosures in zoos
- Behavioural engineering
- 1925 - Robert Yerkes – devices to encourage play and work
- 1950 - Hediger – work for food
- 1982 - Markovitz –  
Restore natural contingency between appetitive behaviour (foraging) and consummatory behaviour (feeding) – behavioural need

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## Uptake

- Zoos – naturalistic approach
- Laboratories – behavioural engineering
- Compatible approaches
  - Outdoor runs in laboratories (weather)
  - Puzzle feeders in zoos



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## Behavioural Needs?

- Some argue behavioural needs can only be met in natural conditions (McKenna et al, 1987) – naturalistic approach.
- Others argue they can be met by other environments/means (Poole, 1998) – behavioural engineering.

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## Types of enrichment

- Housing
- Social environmental enrichment
- Furniture, toys, inanimate enrichment
- Food and foraging enrichment

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## Types of enrichment

- **Physical**
  - Enclosure
    - Size (alteration)
    - Complexity (panels for apparatus)
  - Accessories
    - Internal
      - Permanent (furniture, bars)
      - Temporary (toys, ropes, substrates)
    - External (hanging objects, puzzles)
- **Social**
  - Contact
    - Conspecific (pair, group, temporary, permanent)
    - Contrspecific (human, non-human)
  - Non-contact
    - Visual, auditory, cooperative device
    - Human, non-human
- **Occupational**
  - Psychological (puzzles, control over environment)
  - Exercise (mechanical devices, run etc)
- **Sensory**
  - Visual (tapes, television, images, windows)
  - Auditory (music, vocalisations)
  - Other stimuli (olfactory, tactile, taste)
- **Nutritional**
  - Delivery frequency, schedule, presentation, processing
  - Type (novel, variety, browse, treats)

### TASK

Divide these into  
Naturalistic and behavioural  
Engineering

Adapted from Bloomsmith et al., 1991

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## Why do enrichment?

### Why not?

- Financial costs
- Time consuming
- Potential for harm
- Confounds with science – increasing variability in results

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## Why not?

- Financial costs – may be offset by improvements
- Time consuming – can make part of routine, and built in, rather than add on (eg adding forage to substrate mix)



Cont.

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### Why not?

- Financial costs – may be offset by improvements
- Time consuming – can make part of routine, and built in, rather than add on
- Potential for harm – can minimise risks with proper safety evaluation (**LATER**)
- Confounds with science – increasing variability in results

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### Why do enrichment?

- Ethical responsibility to welfare
- Public pressure
- Legislation
- **Science**
- Benefit to carers



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### Impact of EE on Science

- EE should prevent (or reduce) abnormal behaviours and improve animal well-being, but concerns that it may also disrupt standardization, reducing the precision and replicability of animal experiments.
- EE need not disrupt standardization (a flawed concept creating results with poor external validity?)

Wurbel and Garner– NC3RS website

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### Evidence that Enrichment works?

- Behavioural
- Physiological
- Neurological

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### Recap on EE goals

- Increase diversity and performance of **normal** (wild, desired) behaviours
- Increase behavioural choices
- **Prevent** abnormal behaviour developing (Reduce the frequencies of abnormal behaviours)
- Increase positive utilisation of the environment
- Increase ability to cope with challenges in a more normal way

(adapted from various sources)

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### Primates – Behavioural Evidence

- Reduction in abnormal behaviours (rhesus macaques - O'Neill et al, 1991; Markovitz et al, 1995)
- Reduction of injurious behaviours (cynomolgus macaques - Holmes et al, 1995)
- Reduction in aggressive behaviours (stumptailed macaques - Estep & Baker 1991)
- Reduction of fear of being handled (marmosets- Bassett et al, 2003)
- Increases in behavioural diversity (capuchins - Ludes-Fraulob & Anderson 1999)
- Increases space utilisation (rhesus macaques - Lutz and Novak, 1995)
- Promotion of behaviour patterns perceived as desirable (rhesus macaques - Platt & Novak, 1997; marmosets - Ventura and Buchanan-Smith, 2003)
- Control over aspects of the environment (guenons - Sambrook & Buchanan-Smith, 1997; barbary macaques - Vick et al, 2000; marmosets - Badihi & Buchanan-Smith, in prep).
- Increased learning ability, meet behavioural needs/fulfils motivational requirements (Swaisgood et al, 2001)
- Faster infant development (marmosets - Ventura & Buchanan-Smith, 2003)

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## Primates – Physiological Evidence

- Reduction in plasma cortisol (capuchins – Boinski et al, 1999, macaques - Schapiro et al, 1993)
- Increased immune response (rhesus macaques - Schapiro et al, 2000; cynomolgus macaques - Capitanio & Lerche, 1998)
- Increased body weight from same food consumption (rhesus – Schapiro & Kessel, 1993)
  
- In non-primates reduced stomach ulceration, increased noradrenalin levels, changes in blood cell parameters.

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## Neurological Evidence

### Primates

Subject-environment interactions play a crucial role in the maintenance of basic organizational features of somatosensory representations

### Rodents

- Increased brain cell density
- Speeds recovery from brain damage – cellular recovery
- Changes to brain biochemistry to augment learning or cognition
- Recovery of cognitive function following brain damage or cerebral deterioration
- Recovery of motor abilities following brain damage
- Enhanced spatial and non-spatial memory
- Increased brain weight and size
- Improved visual perception
- Modifications of brain emotional systems

From Young, 2003

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## What actually improves welfare?

- Reduces boredom
- Empowerment – giving opportunities for choice and control....
- Reduction in fear – often associated with increased predictability
- Self reinforcing – enjoyment
- Information gathering rather than hedonistic
- Motivated to do what he/she wants..

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