

# Variability of the detection response of explosive detection dogs (EDD) faced with varying quantities of RDX-type explosives

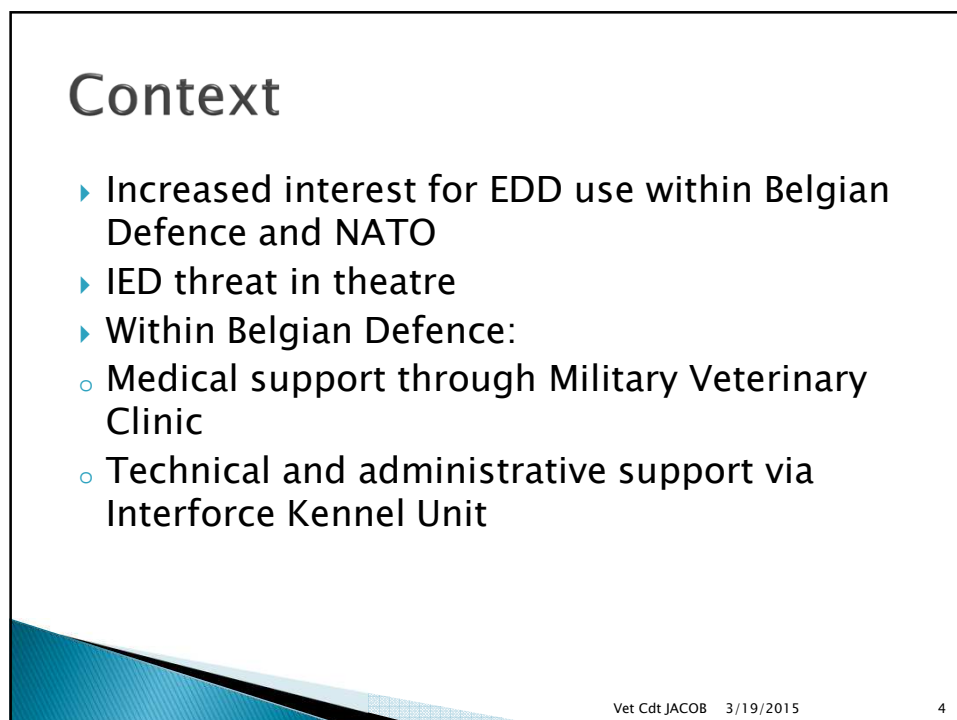
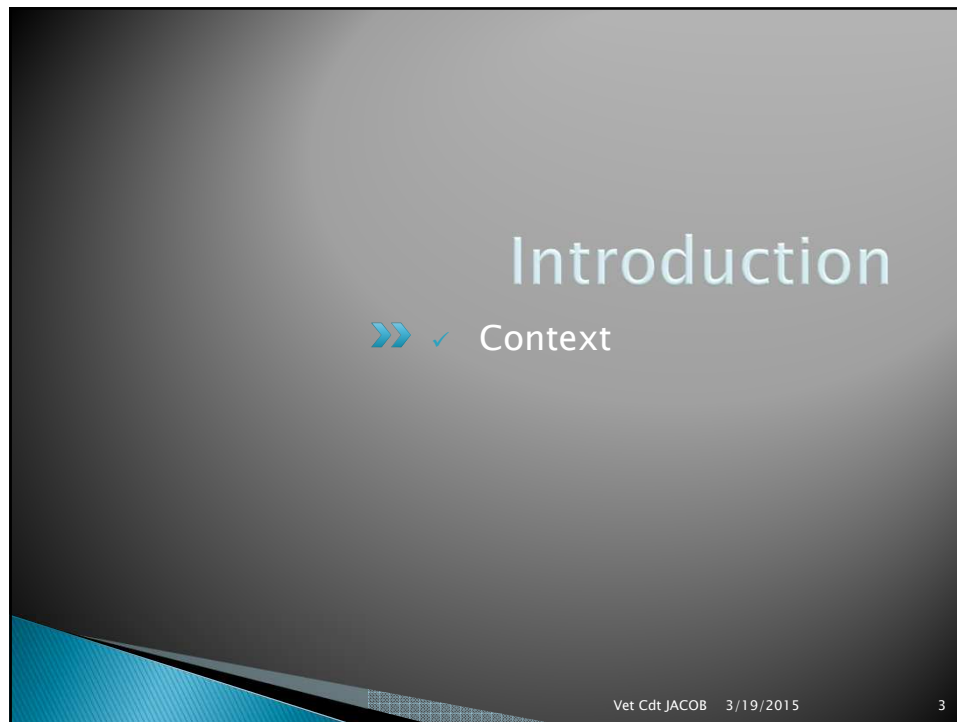
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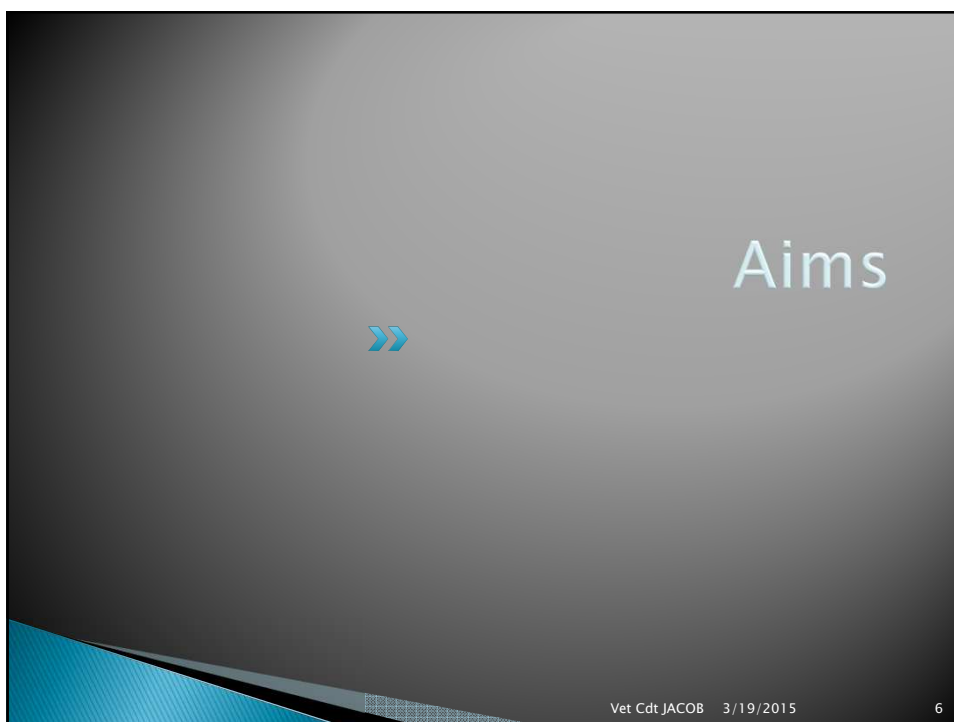
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## Aims

1. To determine the main factors of influence of canine explosive detection (literature study)
2. To determine a possible variation in the canine response when faced with different quantities of RDX
3. To formulate recommendations in various areas (selection, training and operational use of EDD)

## Facts and figures

- » ✓ Belgian Defence EDD
- ✓ Olfaction
- ✓ Explosives

## Belgian Defence EDD

- ▶ 1 team = 1 EDD + 1 dog handler
- ▶ 2 types :
  - EDD Sy
  - EDD Engr
- ▶ Total number of Military Working Dogs: 304
- ▶ Of which 50 EDD

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## Belgian Defence EDD

- ▶ IED detection, single use
- ▶ No landmine detection capability
- ▶ 25 weeks initial training + annual certification
- ▶ Real explosive training

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## Olfaction

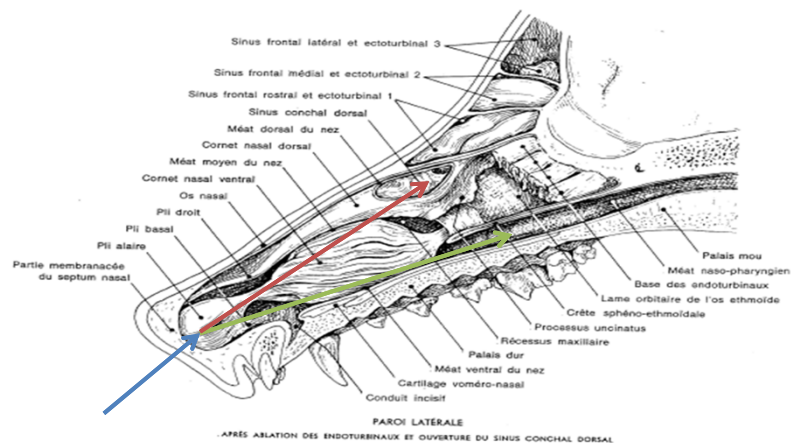


- ▶ Olfaction = The number one sense in the dog
- ▶ Olfactive tissue: 200cm<sup>2</sup> (German Shepherd) vs 10 cm<sup>2</sup> (human)
- ▶ Gene number coding olfactive receptors: 1300 (canine) vs 800 (human)
- ▶ Detection threshold: 4x10<sup>5</sup> vs 4x10<sup>9</sup> molecules/cm<sup>3</sup>
- ▶ Air flow and odour perception

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## Air flow



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## Olfaction

- ▶ A few important concepts:
  - Detection threshold
  - Intensity variation and air cone
  - Adaptation
  - Discrimination
  - Generalization
  - Olfactive memory

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## Explosives

- ▶ In operational theatre IED or HME
- ▶ Training, trainer-aids vs explosives
- ▶ Explosive composition
- ▶ Volatility



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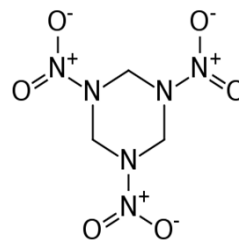
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	Explosives	Trainer-aid (NESTT®)	EMPK
Safety	No	Yes because dispersed active principle	Yes because of very small quantity
Toxicity	Yes	Yes but very low because dispersed active principle	No
Legal Implication	Yes	No	No
Direct Cost	+	++	++
Indirect cost (storage, transport,...)	++	+	+
Direct efficacy	Yes	Yes	Yes
Indirect efficacy (generalization)	Yes	decreased	decreased
Contamination risk	Yes ++	Yes++	Yes+/-
Detection threshold	Stable	decreased	Strongly decreased

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## Explosives

- ▶ Use of RDX (M112) in the study for several reasons:
  - Training
  - Operational
  - Security
  - Practical





## RDX

- ▶ Detonation speed: 8750 m/s vs sound speed 340 m/s
- ▶ 1 kg of explosive produces 908 l of gas when detonated
- ▶ Heat of explosion: 1300 cal/kg
- ▶ Up to 2 times more powerful than TNT
- ▶ Used in terrorist attacks: for e.g. Moscow metro attack in 2010: 1 to 2 kg of RDX per kamikaze => 40 killed and 102 wounded

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## Variability factors

- ▶ Intrinsic factors
- ▶ Extrinsic factors

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## Variability factors

- ▶ Influence on olfaction and explosive detection by EDD
- ▶ Classification following:
  - Intrinsic influence
  - Extrinsic influence



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## List of main variability factors

### Intrinsic factors

- ▶ Anatomic and racial variation
- ▶ Illness
- ▶ Iatrogenic
- ▶ Cognitive capacity
- ▶ (Age)
- ▶ (Sex)

### Extrinsic factors

- ▶ Training method
- ▶ Training means
- ▶ Human influence
- ▶ Experience of canine
- ▶ Nutrition
- ▶ Physical condition
- ▶ Climate and environment
- ▶ Explosive

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# Study

- ✓ Aim
- ✓ Material and method
- ✓ Results
- ✓ Discussion

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## Aim

► Study aim can be divided into 3 main questions:

1. *Is the EDD capable of precise detection of unusually (training wise) large quantities of explosives?*
2. *Is there a different EDD detection response when faced with variable quantities of explosives (what behavioural reactions can be considered significant)?*
3. *Are there significant unwanted behaviours during detection of larger quantities of explosives?*

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## Material and method

- ▶ 19 EDD teams
- ▶ RDX type explosive: M112 bar
- ▶ 3 quantities : 57g, 570g and 5,7 kg
- ▶ 4 military storage shelters (one “blank”)
- ▶ In each one: line-up of 7 rucksacks, one of which contains a variable quantity of RDX
- ▶ “Blind” study

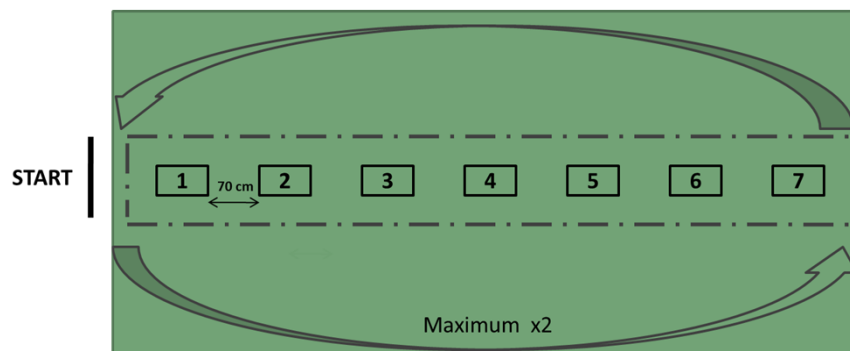


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## Material and method

Study course V :



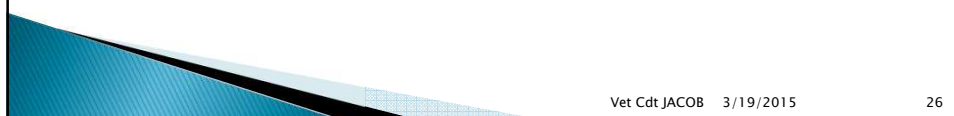
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## Material and method

- ▶ Binary system measurement method.
- ▶ Detection was divided in 3 possibilities:
  - Detection, false detection, no detection
- ▶ Behavioural reactions:
  - Scratching, barking, whining, biting in rucksack, nervous, nose in bag, paw on bag and sniffing (at a distance)
- ▶ Statistics (Cochrane Test and Post-Hoc Comparison)



## Results

- ▶ Marking:
  - *Cochrane*: detection proportion, false detection and no detection vary following quantity of RDX (statistically significant)
  - *Post Hoc*: no significant comparisons for false detection
- ▶ Behavioural reactions:
  - *Cochrane*: 3 significant behaviours (« nervous », « sniffing » et « nose in bag »)
  - *Post Hoc*: no significant comparisons

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## Discussion

- ▶ Results can be linked to the established aims of the study :
  1. Precise detection of large quantities
  2. Behavioural variation in function of explosive quantity detection (3 statistically significant behaviours)
  3. Unwanted behaviour (« biting » and « paw on bag »)
- ▶ Conclusion following false detection in shelter 4 : nose saturation, EDD false positive or handler influence

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## Conclusion and way to go



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## Conclusions

- ▶ Identification of factors of influence on olfaction and explosive detection
- ▶ Variation of canine behaviour faced with varying explosives quantities
- ▶ 3 significant behaviour traits when in contact with larger quantities of RDX

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## Way to go

- ▶ Can be divided in the different phases of the military working dog:
  - Purchase
  - Maintenance
  - Training
  - Reform

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## Way to go

- ▶ EDD purchase:
  - Cognitive test (predictive test)
- ▶ Maintenance:
  - Specific nutrition
  - Physical training plan



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## Way to go

- ▶ Training (continued):
  - Reward method (discontinued)
  - Variation of explosives (quality/quantity)
  - Masking substances
  - Blank exercises
  - Environmental and climatic condition variation => dog handler training
  - Guidelines ( BE and NATO)
- ▶ Training conditions to closely mimic operational reality

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## Way to go

- ▶ Reform age:
  - Age has negative effect on olfaction BUT...
- ▶ Operational efficiency can be increased by better control of factors of variability

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