

INTRODUCTION

- Sensory incorporation studies show that the sleeping brain in REM sleep is able to process information
- Dream content reacts to external stimulation in both direct and indirect fashion (e.g. Nielsen, 1993; Schredl et al, 2009)
- Sensory information of many modalities (somatosensory, auditory, visual, olfactory) has been shown to produce an effect on dream content
 - But "success" rate ranges from 9% to 87% due to high variability of interventions
 - and due to high variability of what is considered a successful incorporation
- The most effective method of sensory stimulation in sleep is somatosensory stimulation

Objective:

To characterize how REM sleep dreams change in response to somatosensory stimulation of an ankle

METHODS

- 35 healthy participants were randomly assigned to two groups: stimulation, **STIM** (n=20), and control **CTL** (n=15)
- Both groups were fitted with standard polysomnography (frontal, central and occipital EEG; vertical and horizontal EOG, chin and leg EMG, EKG) and with a blood pressure
- Participants slept for a daytime nap in the laboratory, where they were given an opportunity to sleep for about 90 minutes.
- STIM** group was subjected to a somatosensory stimulation after about 5-10 minutes of stable REM sleep has elapsed. The stimulation lasted for approximately 3-5 minutes
- Dream reports were collected following awakening from REM sleep
- Independent judges, blind to participant condition (STIM or CTL) then identified passages in dream reports which were potentially associated with feeling of pressure in the leg. Using thematic analysis, the following main themes were identified: *Intensified motion*, *alterations in body*, *alterations in space*, and *movement/action inhibition*

RESULTS

Dream attribute	STIM	CTL	χ^2	p
Intensified Motion	Yes(13) No(7)	Yes(5) No(10)	3.441	.064
Body alteration	Yes(14) No(6)	Yes(3) No(12)	8.578	.003
Space alteration	Yes(6) No(14)	Yes(1) No(14)	2.917	.088
Inhibition	Yes(11) No(9)	Yes(7) No(8)	.238	.625
Leg imagery	Yes(6) No(14)	Yes(2) No(13)	1.350	.245
Any incorporation	Yes(17) No(3)	Yes(8) No(7)	4.212	.040

- 17 **STIM** group participants (85%) incorporated somatosensory stimulation into dream content.
- Dreams contained both direct and indirect incorporations of the pressure cuff
- STIM** group also showed higher rates of dreams about the laboratory (p=.04)
- No differences were found between groups for *direct* incorporations of leg imagery
- STIM** group showed higher rates of dream themes with *body alteration* and trends towards higher rates of *intensified movement* and *space alteration*

Relevant dream report excerpts	Incorporation
<i>I was doing a check list of what I was supposed to take with me and I realized that I forgot the blood pressure cuff, and I was not really sure if it was mine ore belonged to the laboratory...</i>	Pressure cuff
<i>I walked into a hallway and found many children with disabilities playing there, supervised by adults. (...). A 17 year old with some sort of disability laid down on the floor in front of me and grabbed me by the ankles...</i>	Leg imagery
<i>A robot girl had knife legs and she was cutting her own body... the blades they were cutting like butter, it was bizarre</i>	Body alterations
<i>At first I was flying... there were mountain tops everywhere, there was snow (...) then I found myself on a boat, it was stormy I was holding on to a prow, when the boat was tilting, I could touch the water (...). Suddenly, a dolphin took me and I was swimming on its back.</i>	Intensified motion
<i>I didn't go to the bathroom because there was wax on the floor</i>	Space alteration
<i>I see the video of my room, and I see myself sleeping, but there is a window behind me and my hand is up hanging out of the window in a very uncomfortable position.</i>	Body alteration

DISCUSSION

- Dreams under somatosensory stimulation during REM sleep show both direct and indirect incorporations
- This phenomenon likely reflects processes of multisensory integration, by which a new sensation is interpreted within the ongoing dream scenario (Nielsen, 2017).
- The incorporations often included changes in dream content which were not only somatosensory/vestibular, but also visual and auditory, representing a potential *synesthetic* quality of sensory processing in sleep
- One of the proposed dream functions is the process of integrating new information into existing networks (meaning extraction, associativity), and stimuli incorporation may represent some of its mechanisms
- This work has implications for the role of bodily sensations in perceptual and imagination processes in sleep in particular and in cognition in general, supporting some of the notions of the Embodied Cognition framework (Varela, Thompson & Rosch, 1991)

References

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