Involuntary Musical Imagery While the Mind Wanders: An Experience Sampling Study using Bayesian Networks

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Involuntary musical imagery (INMI)

- Very common phenomenon, experienced by 92% of people at least once per week (Liikkanen, 2012).

- Spontaneous thoughts, either in the form of INMI or other kinds of Involuntary Memories, are a common phenomenon that affects most of the people multiple times per day (Kvavilashvili & Mandler, 2004).

- 30%-50% of our daily thoughts are unrelated to the task at hand (Killingsworth & Gilbert, 2011).

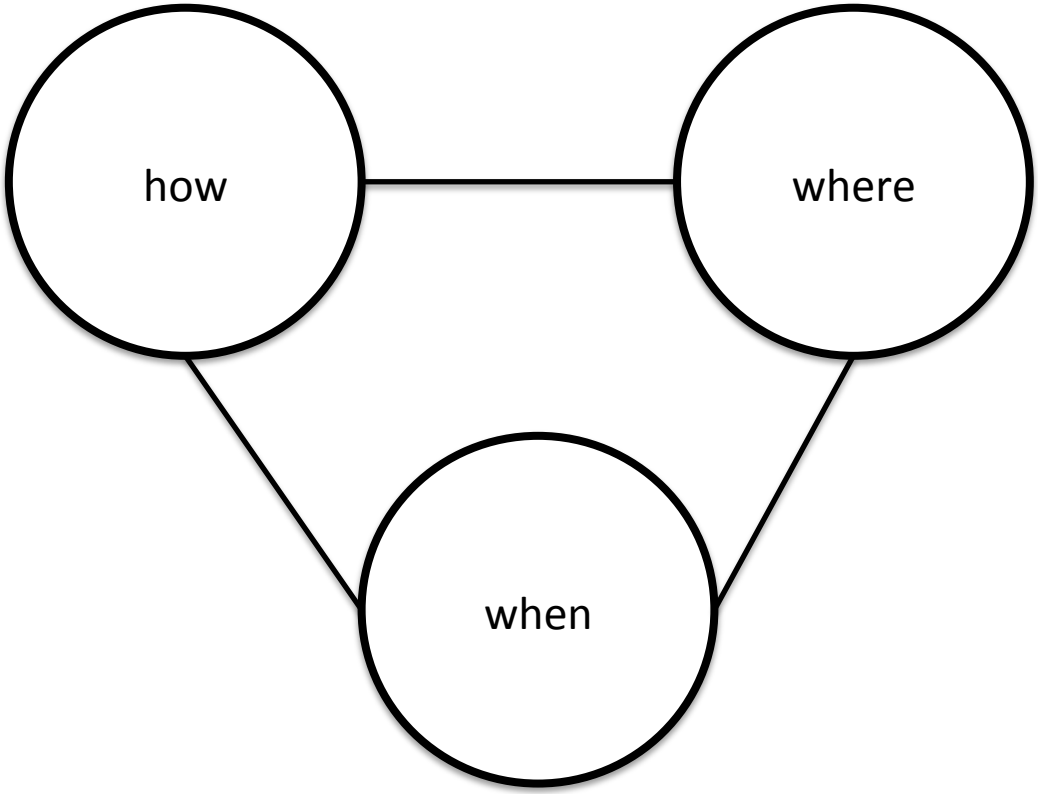
Primary determinants of INMI

The basic conditions which determine the appearance of INMI can be summarised under three categories:

- When? Low attentional demand and monotonous tasks (Williamson et al., 2012; Hyman, 2013) but also during cognitively challenging activities (Hyman, 2013)

- Where? Travelling, working, exercising (Liikkanen, 2012)

- How? Recent exposure to the music, Memory Triggers, Affective States (Williamson et al., 2012)


how
where
when

Method

Participants

38 participants (24 females, 14 males) from the earwormery.com database, aged 18-73

Material

Experience Sampling Booklets (42 forms each)

Procedure

- Experience Sampling Method (ESM)
- 6 text messages per day for 1 week
- At each prompt (via sms) participants reported any current INMI and mind wandering episodes but also the time, activity, mood, INMI triggers and pleasantness and finally mind wandering content.

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Experience Sampling Form

Date: Time when message was received: am/pm Time when form was filled: am/pm

A.

At the time of the beep (when the text message came in)

1) I was experiencing an earworm(s) YES/NO

2) My mind had wandered to something other than what I was doing. YES/NO

If NO, go to question 10; if YES, how would you rate the following statements? (1=not at all, 4 moderately, 7=very much)

3) I was aware my mind was wandering in the moments before the beep	1 2 3 4 5 6 7
4) I allowed my thoughts to wander on purpose	1 2 3 4 5 6 7
5) I was thinking about personal concerns or things I need to do	1 2 3 4 5 6 7
6) I was daydreaming or fantasizing about something	1 2 3 4 5 6 7
7) I was worrying about something	1 2 3 4 5 6 7
8) I was remembering something	1 2 3 4 5 6 7
9) My mind was occupied only by the earworm	1 2 3 4 5 6 7

10) What were you doing? (PLEASE UNDERLINE)

Housework, getting dressed, in the bath, travelling, working, studying, reading a book, shopping, exercising, socializing, listening to music, other (please specify) _____

11) How would you rate the way you were feeling (tick in the Table below)?

	Very	Quite	Somewhat	Neither	Somewhat	Quite	Very	
Alert								Drowsy
Happy								Sad
Tense								Relaxed
Interested								Bored
Energetic								Tired
Lonely								Connected

If you're not experiencing an earworm (if you replied NO to question 1) then do not answer section B.

B.

12) Can you name the title and the artist of your earworm tune? YES/NO

Title _____ Artist _____

13) How would you rate the pleasantness of the earworm? 0-10 (0=not at all pleasant, 10= love it) _____

14) Can you give a possible explanation of how the earworm was triggered?

☐ I heard it recently (Please specify by circling: private music (e.g. home/car), public music (e.g. restaurant, shop), radio, live music, ringtone, contagion, learning, other_____)

☐I saw a person that reminded me of it ☐I heard a sound that reminded me of it

☐A word that I saw or heard was somehow connected with the earworm

☐An recent or upcoming event made me think of it ☐A dream that I had is connected with the tune

☐It expresses my current thoughts at this moment/period

☐Other (please specify) _____

Data Analysis

Multivariate dataset based on 1374 episodes:

- Analyzed using **a Bayesian Network** approach, which enables the identification of dependencies within a set of variables as well as the testing of hypotheses regarding causal influences and directed structural relationships.

- Combination of probability theory, computer science, graph theory and statistics

Bayesian networks and their underlying structure can be estimated with a variety of algorithms, which can be:

- *constraint based*, which perform conditional independence tests
- *score based*, which provide goodness-of-fit scores and
- *hybrid,* which are a combination of the above.

Results

Three different networks were constructed

1. General INMI-Mind wandering Bayesian Network
2. INMI oriented Bayesian Network
3. Mind Wandering oriented Bayesian Network

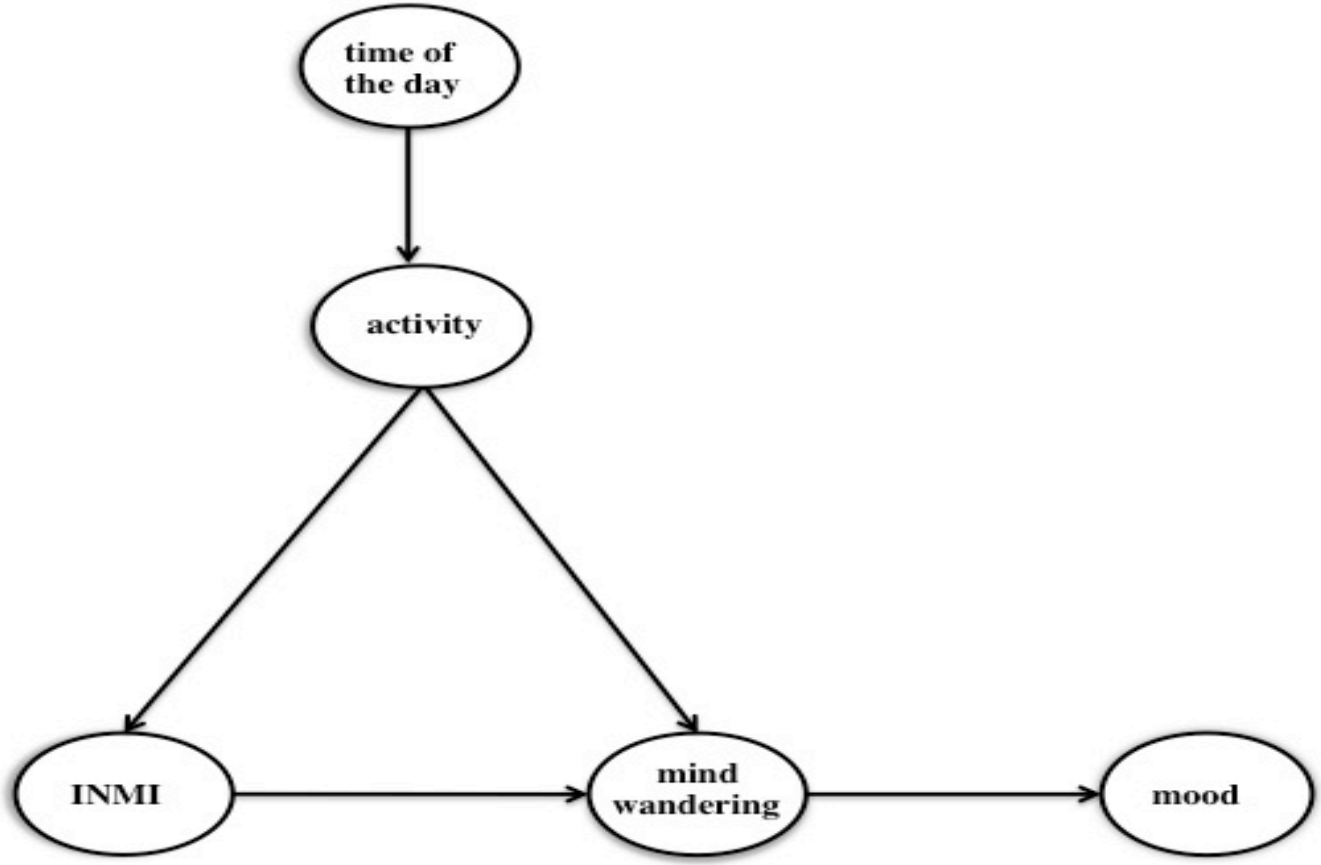
1st Network

- 1374 observations

- Five core variables

  1) Time of the day (08:00-13:00, 13:01-18:00, 18:01-23:00)
  2) Activity (working, socializing, housework, audio/visual, travelling, physical movement, low attention states, computer & leisure, high cognitive load)
  3) Mind Wandering (yes, no)
  4) INMI (yes, no)
  5) Mood
     -calm
     -serene
     -happy
     -excited

Results: 1. General INMI-MW Bayesian Network



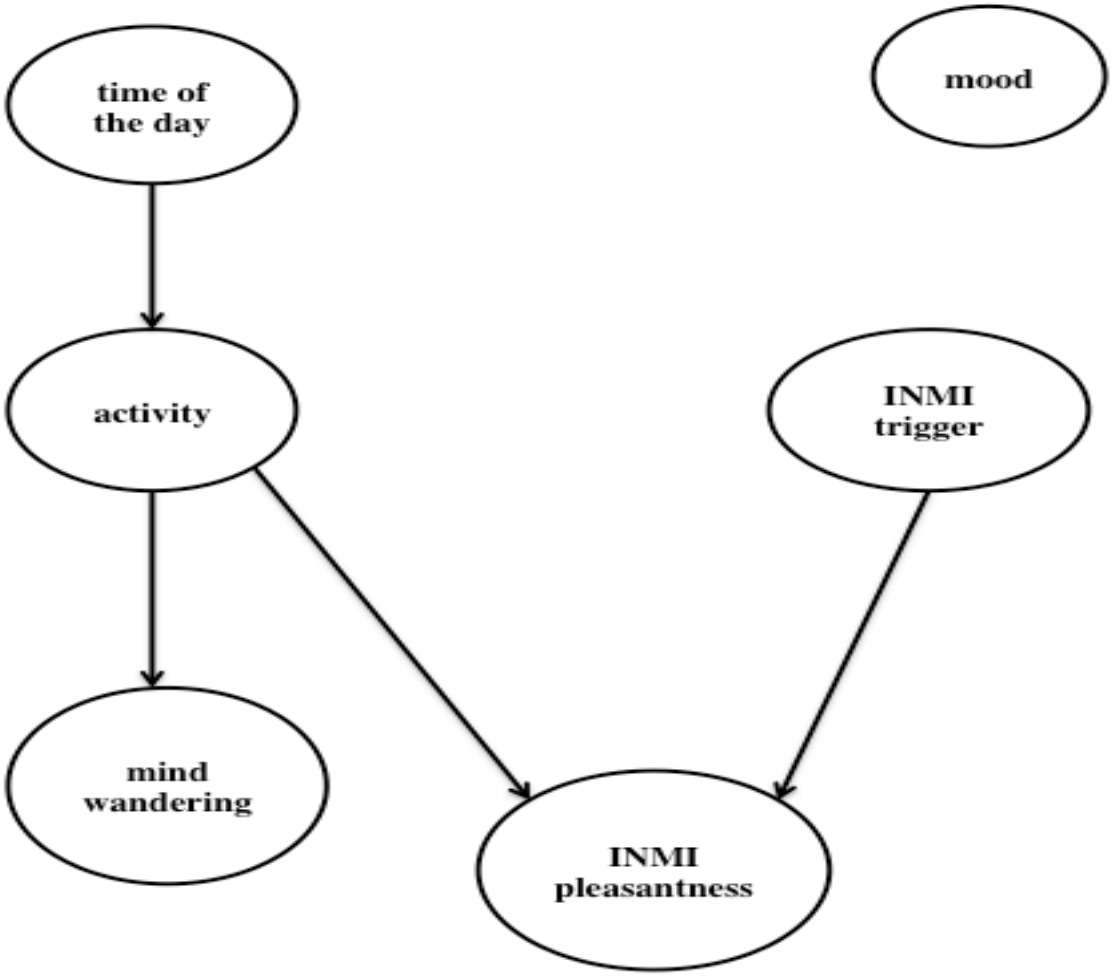
2nd Network

- 644 observations

- Six core variables

  1) Time of the day (08:00-13:00, 13:01-18:00, 18:01-23:00)
  2) Activity (working, socializing, housework, audio/visual, travelling, physical movement, low attention states, computer & leisure, high cognitive load)
  3) Mind Wandering (yes, no)
  4) Mood
  5) INMI triggers (Exposure, Association;Person, Association;Sound, Association;Word/Image, Recent/Upcoming event, Thoughts/ Dreams, No Idea, the same INMI, Default INMI, Memory)
  6) INMI pleasantness (low, medium, high)

Results: 2. Bayesian Network when INMI is experienced



Results: 3. Bayesian Network when MW is experienced

Conclusions

- Confirmation of the relationship of INMI with mind wandering especially during low attention states activities (Williamson et al., 2012; Hyman et al., 2013).

- Independence of INMI from the time of the day - dependence only on the activity - higher INMI probability ➔ low attentional demand activities, housework, travelling.

- ↑ pleasantness – default INMI – low attentional demand activities but

  ↓ pleasantness – default INMI – demanding mental activities

- Socializing and audio/visual activities prevent INMI

Future Directions

- Laboratory studies on cognitive load and INMI
- Studies on combination of implicit and explicit measures for mood during INMI
- Mind wandering oriented network
- Identification of causal relationships

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Thank you!

Questions?