Attention ⚠️

Cognitive Control in Media Multitaskers
(Ophir, E., Nass, C., Wagner, A.)

Effects of Intelligent Notification Management on Users and their Tasks
(Shamsi T. Iqbal, Brian P. Bailey)

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"It's not information overload, it's filter failure"

- **Clay Shirkey**

We cannot do anything about the influx of information, we could only *Filter Out* irrelevant information and divert our limited *Attention* towards what matters.

Learning Goals

→ **Understand the impact of media multitasking on human attention and information processing and filtering**

→ **Understand the effect notifications and their content have on people who are working on tasks**

→ **Discuss notifications' ability to manipulate people's behaviors and how it could be abused**

→ **Examine the higher-level effects of the "Attention Economy" on society**

Quick Survey...

Raise your hand if you frequently (try to) multitask

Raise your hand if you think multitasking improves your productivity

Heavy Media Multitasking affects...

- Memory

- Learning

- Cognitive Functioning

Humans are *not good* at processing multiple input streams

Overall brain activity decreases when people multitask [1]

"Is media multitasking frying our brains?"

[1] Marcel Just, Professor of Psychology at CMU

Cognitive Control in Media Multitaskers

Categorizes participants into Heavy Media Multitaskers (HMM) and Light Media Multitaskers (LMM) using Media Multitasking Index (MMI)

- HMMs are worse at filtering out irrelevant stimuli

- HHMs are less selective in allowing information into working memory

- HHMs are less capable of filtering irrelevant representations in working memory

MMI Quantifies the degree of Media Multitasking

Media Mediums taken into account

1. Print Media
2. Television
3. Computer-based Videos
4. Music
5. Non-music Audio
6. Games
7. Voice Calls
8. Instant Messaging
9. SMS
10. Email
11. Web Surfing
12. Other Computer Applications

$$\text{MMI} = \sum_{i=1}^{11} \frac{m_i \times h_i}{h_{\text{total}}}$$
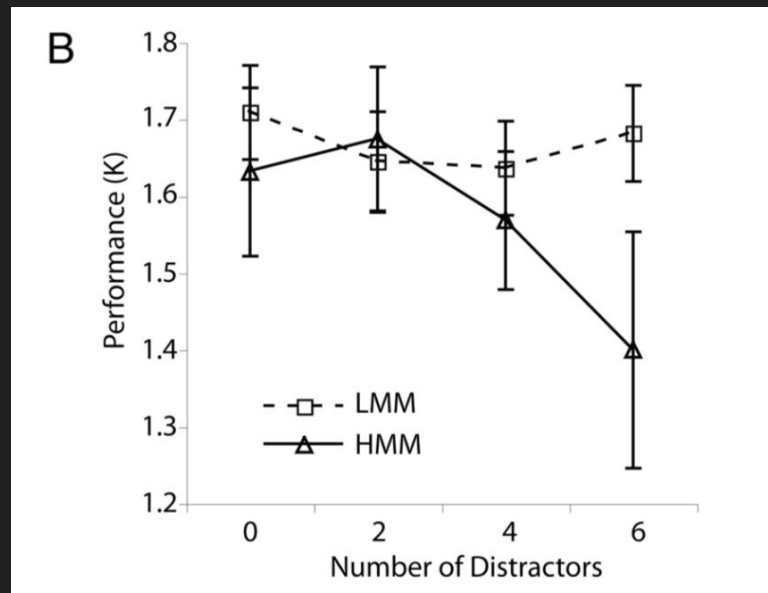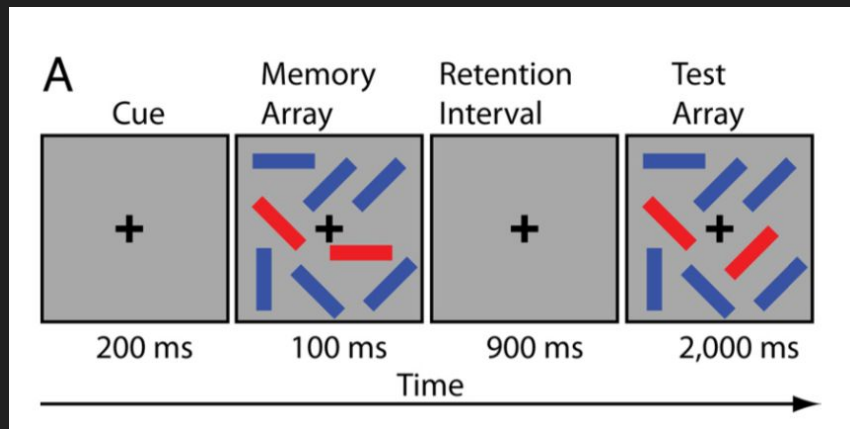
Discussion:

This study used a questionnaire to calculate MMI.

What are the limitations of MMI as a measure of media multitasking?

**Any ideas on how else we could improve MMI?**

1 minute

Filter Task shows **HMMs are worse at filtering out irrelevant stimuli than LLMs**

AX-CPT with distractor letters shows HHMs are less selective in allowing information into working memory

- They take in a wider breadth of information, at the *expense of primary task performance*
- Is this always bad?
- Doesn't this mean they are more perceptive to the environment?
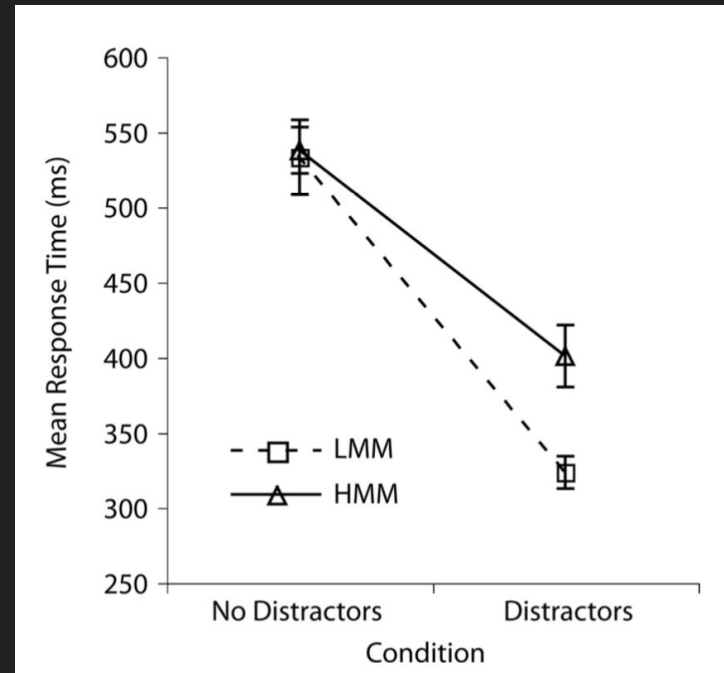
HMMs are worse at focusing down on a single task

BUT...

there might exist benefits for HMMs for *higher-order cognition* tasks

HMMs are biased towards *exploratory* rather than *exploitative* information processing

Discussion:

It's possible that HMM traits could come with certain benefits!

What are some potential (positive) skills that HMMs might possess?

Which kinds of tasks might HMMs perform better on?

2 minutes

Your Commentaries

"...there could be other areas in which heavy media multitasking actually improves cognitive performance. I do believe this to be the case because I think that the changes in how HMMs filter information is an evolutionary change that makes them more fit for the type of tasks they most often engage in, that is, heavy media multitasking." - Heitor Schueroff

"I wonder if this means if "multitasking" can in some sense be used as an aid for distraction. For example, playing white noise effectively "blocks" the audio channel, preventing the transmission of information across it beyond a single continuous signal." - Dylan Lukes

2- and 3-Back Tasks show HHMs are less capable of filtering out irrelevant representations in working memory
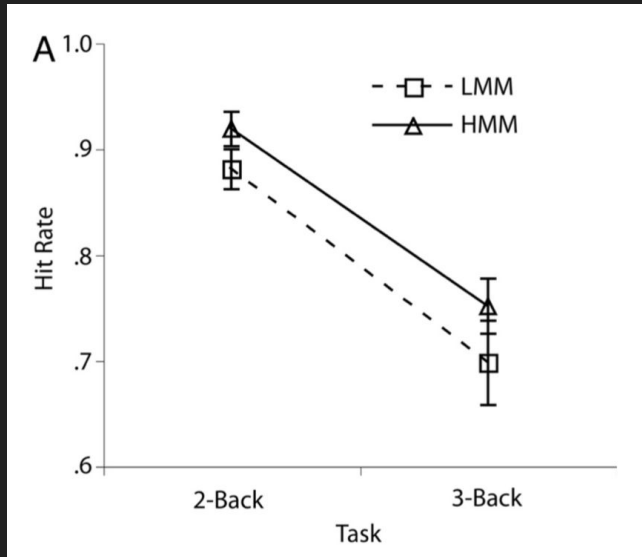
Hit Rate
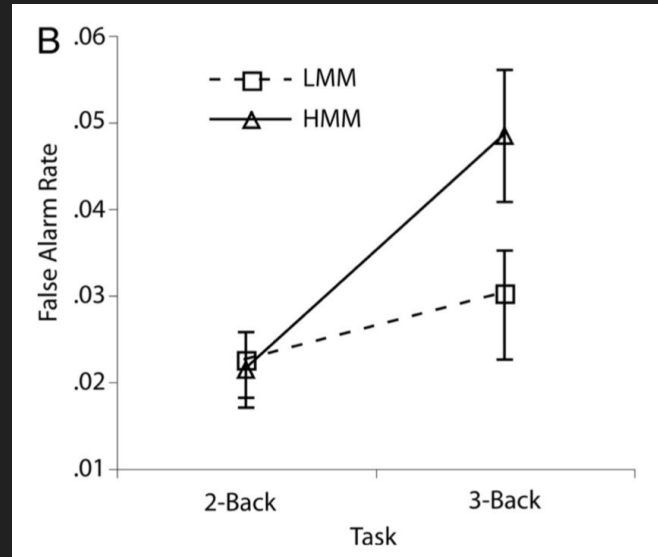
False Alarm Rate

Discussion:

This study had participants perform a set of tasks intended to compare the information processing ability of HMMs and LMMs.

What are the limitations of the tasks used in the study?

Could you think of any other tasks that might be a better measure?

2 minutes

Your Commentaries

"I wonder what the effects of a different, more real world cognitive test not involving rectangles. For example, some kind of information processing task involving reading comprehension." **- Cora Coleman**

"The study is just not generalized enough: while HMMs may be less able to filter out irrelevant details and ignore relevant representations in memory and multitask, perhaps this is all due to the challenge design. I.e. there may be other ways of presenting the challenges that make HMMs come out on top." **- Maxwell Bland**

Imagine you are trying to debug some really ugly code...

- **Your friend taps you on the shoulder..**
    - **"Hey look at this sushi place, we should go there sometime"**
    - **"Oh yes the sushi looks so amazing!"**
- **You revert back to debugging…**
    - **"Hmmm, now, where was I at?"**
    - **"What was I thinking about before I was interrupted?"**
    - **"Hmmm I really want sushi right now"**
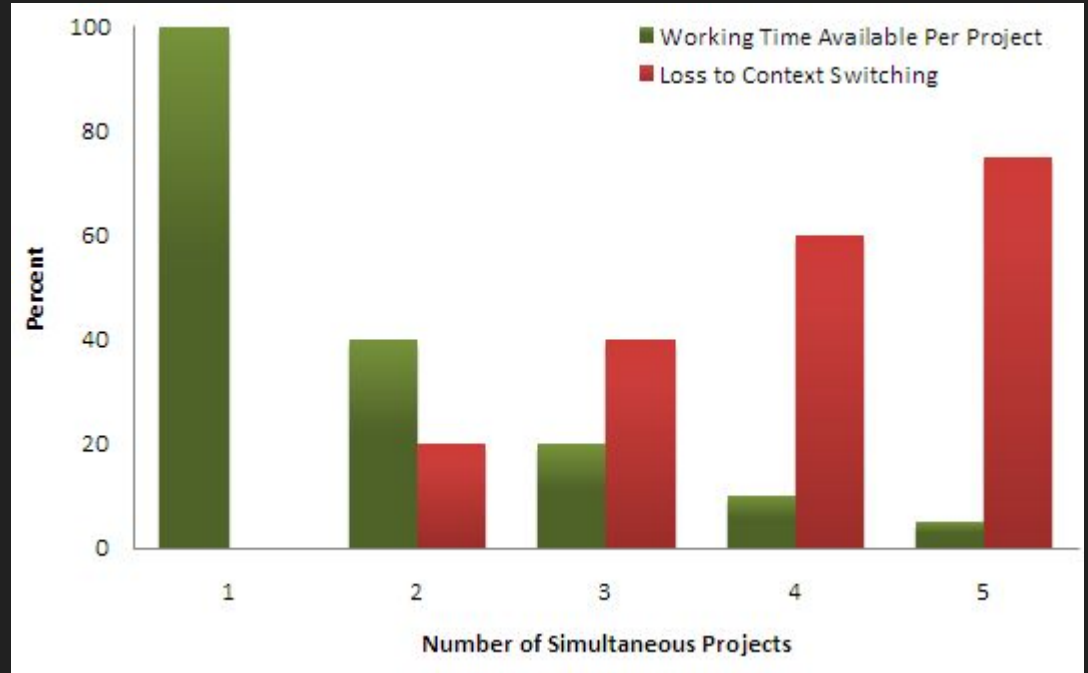   - **"Which line of code was I looking at?"**
    - @#^$&#^$%&^@#

Multitasking causes more Context Switching

You trying to multitask:

- **Talking to your friend about the sushi restaurant**
- **Debugging code**

Context switching costs
time

Legend: Working Time Available Per Project (green), Loss to Context Switching (red). X-axis: Number of Simultaneous Projects. Y-axis: Percent.

A Breakpoint is an Interruptible Moment

A transition from one (meaningful) task to another

What if your friend waited until…

- You finished debugging one part of the code

- You decide to take a break

It would be a lot less annoying…

You were going to context switch anyways

He/she is interrupting you at your *breakpoint*

Effects of Intelligent Notification Management on Users and Their Tasks

- **Created Oasis: system that defers notifications to breakpoints**
    - **Uses statistical models to detect and classify breakpoints**
    - **3 Breakpoint types: fine, medium, coarse**
- **Users preferred notifications be delivered at breakpoints**
- **Relevance of notifications matter!**
- **Users preferred:**
    - *Relevant notifications at finer breakpoints*
    - *General notifications at coarser breakpoints*

Oasis Architecture
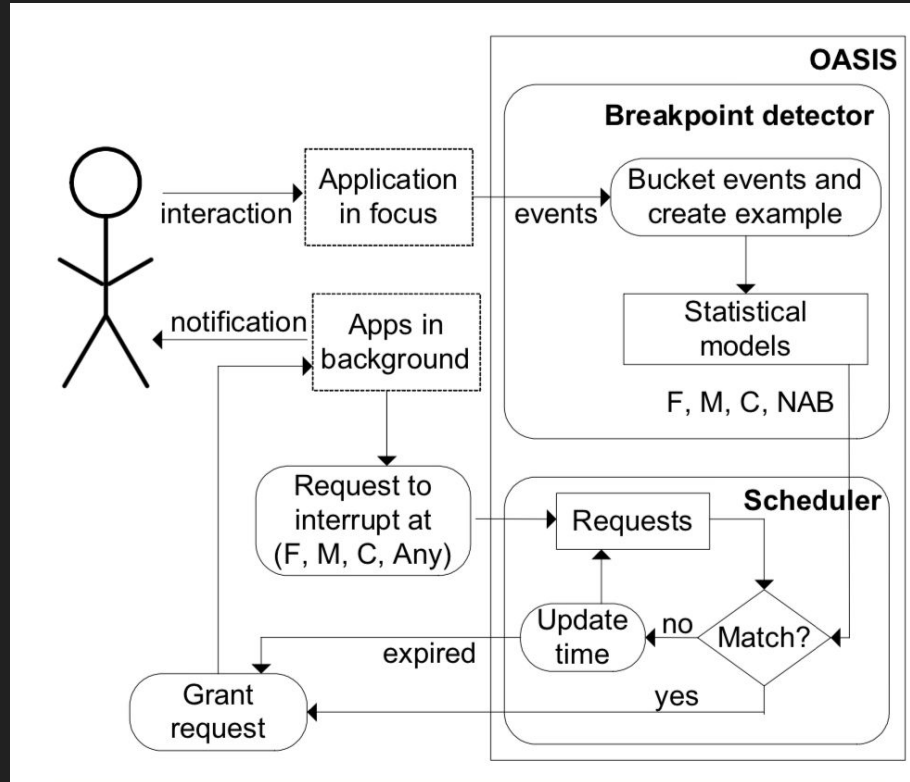
Discussion:

The authors used independent observers to identify breakpoints for the initial training set.
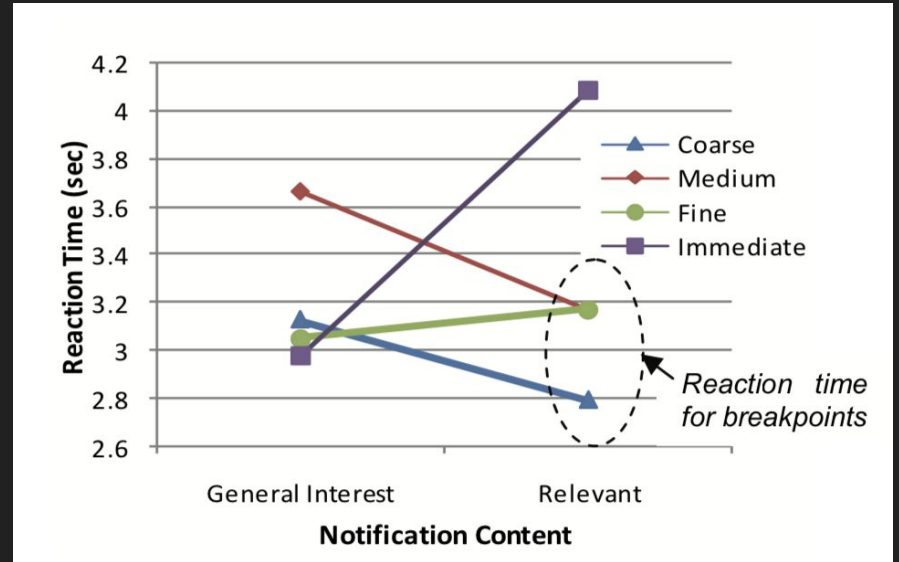
Why did the authors decide to do this?

Would it have been better to have the participants identify the breakpoints themselves?

1 minute

Time and Relevance of Notifications affect Reaction Time

- Faster reaction to relevant notifications at breakpoints

- Slower reaction to relevant notifications delivered at non-breakpoints

Relevance of the Notification affects Frustration Level and Task Resumption Time

- General content notifications caused more frustration than relevant ones

- Users resumed tasks faster after relevant notifications

Users prefer:

- *Relevant Notifications at Finer Breakpoints*

- *General Notifications at Coarser Breakpoints*

Discussion:

Let's relate this study back to the idea of HMMs and LMMs...

If this study were conducted with MMI as an independent variable, what kind of relationship would you expect to see?

How differently would HMMs respond to notifications compared to LMMs?

2 minutes

Notifications could Manipulate People's Behavior

When relevant notifications were delivered at coarse breakpoints, users tend to abandon the task switch.

They *were frustrated by this.*

Users also responded quickly to notifications at non-breakpoints.

They are *easily distracted by notifications.*

"Nagging" with Push Notifications is Effective

Discussion:

We see that notifications are able to manipulate the user's behavior

What are the dangers of this potential to manipulate behavior?

Can you give examples of notifications that (maliciously) try to manipulate your behavior?

2 minutes
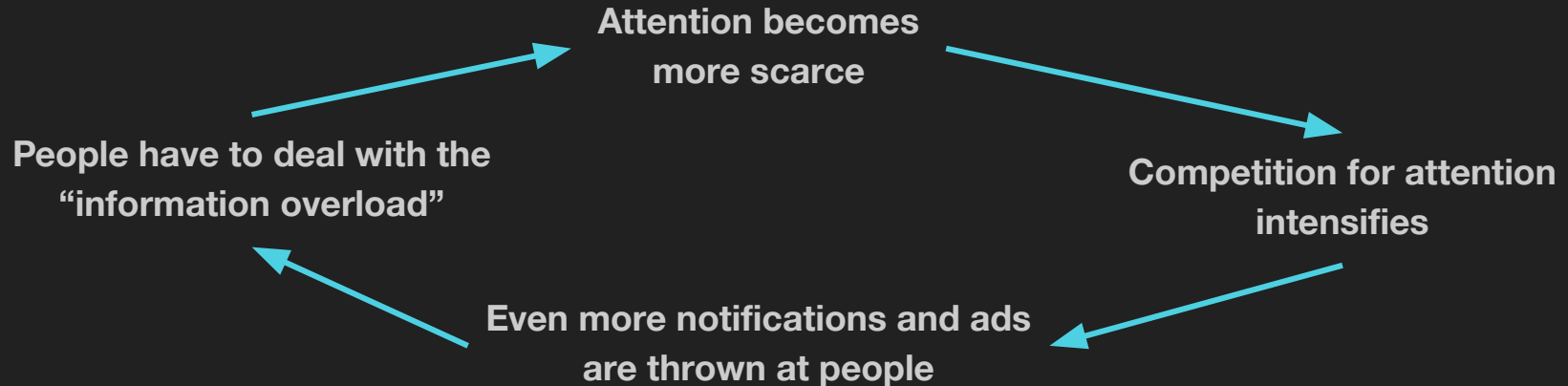
Notifications cause Addiction

- *Dopamine-driven* feedback from likes, comments, etc.
- Social reward
- Addictive, short-term pleasure
- You will always want more, just like drugs
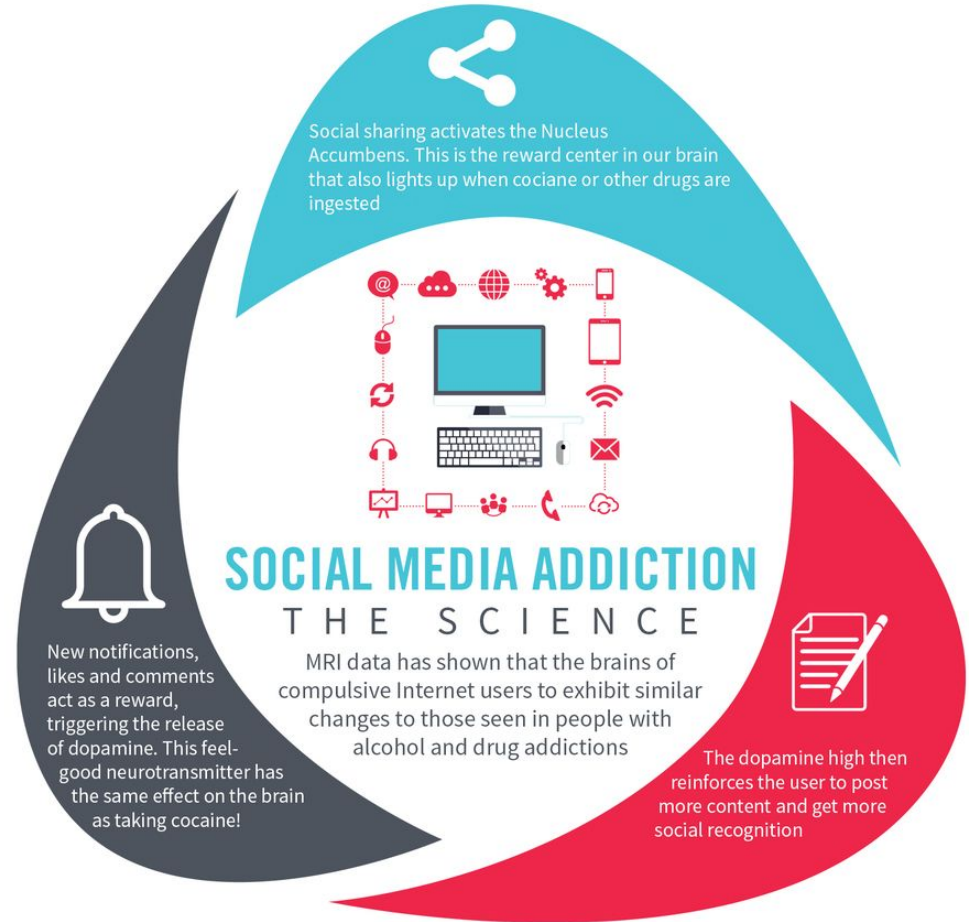
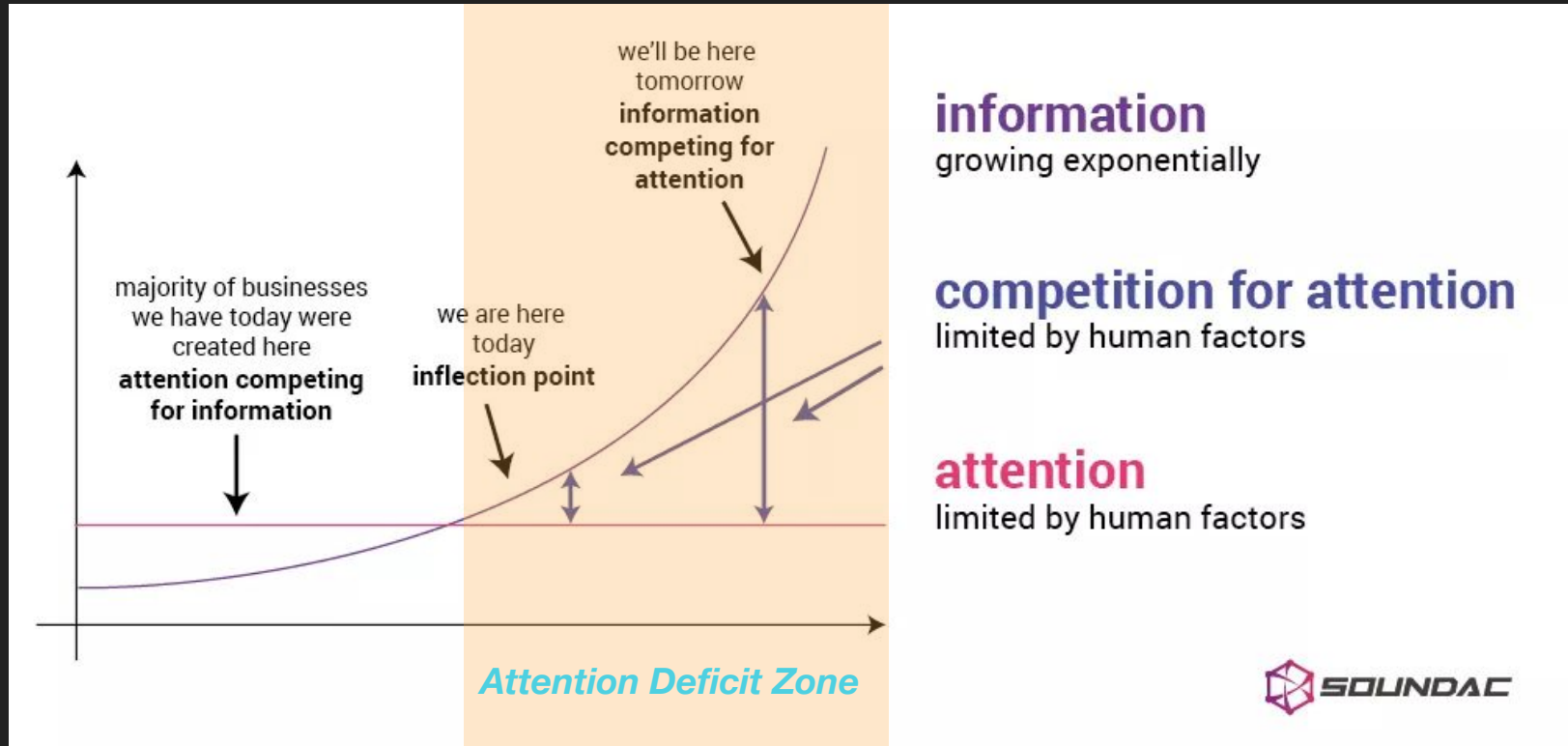# In a World where Everyone is Competing for your Attention...

Modern (internet) advertisement and apps relies on grabbing your attention to make money

This *Attention Economy* creates a *Feedback Loop*

Attention becomes more scarce

Competition for attention intensifies

Even more notifications and ads are thrown at people

People have to deal with the "information overload"

Attention is reaching the point of Deficit

we'll be here tomorrow
information competing for attention

majority of businesses we have today were created here
attention competing for information

we are here today
inflection point

information growing exponentially

competition for attention limited by human factors

attention limited by human factors

Attention Deficit Zone

SOUNDAC

Discussion:

What do you do (if anything) to control/limit your access to social media and/or notifications?

What benefits have you felt?

1 minute

But people have always complained about new technology ruining society...

Discussion:

Is the smartphone/internet revolution more "dangerous" that the newspaper or television revolution?

What fundamental differences are there between them?

2 minutes

Thank You!

What we learned today:

✓ **Understand the impact of media multitasking on human attention and information processing and filtering**

✓ **Understand the effect notifications and their content have on people who are working on tasks**

✓ **Discuss notifications' ability to manipulate people's behaviors and how it could be abused**

✓ **Examine the higher-level effects of the "Attention Economy" on society**