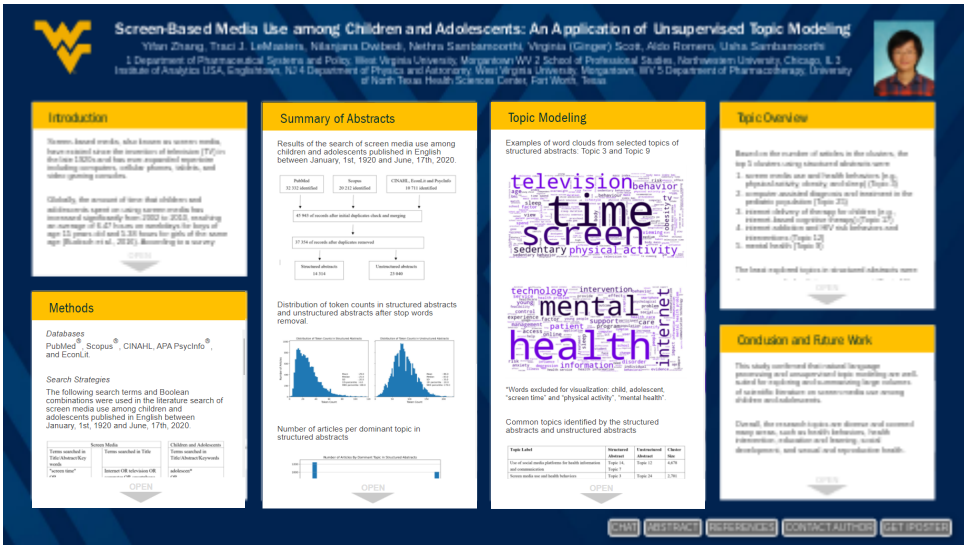
Screen-Based Media Use among Children and Adolescents: An Application of Unsupervised Topic Modeling



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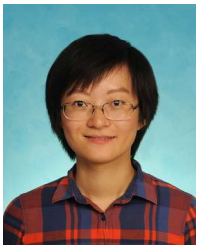

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INTRODUCTION

Screen-based media, also known as screen media, have existed since the invention of television (TV) in the late 1920s and has ever-expanded repertoire including computers, cellular phones, tablets, and video gaming consoles.

Globally, the amount of time that children and adolescents spent on using screen media has increased significantly from 2002 to 2010, reaching an average of 6.47 hours on weekdays for boys of age 15 years old and 5.38 hours for girls of the same age (Bucksch et al., 2016). According to a survey conducted by the Pew Research Center in 2018, as many as 45% of teens said they are online on a near-constant basis, up from 24% in 2015 (Pew Research Center, 2018)

Screen media research is growing, from about a total of 100 publications in the 1990s to more than 5000 articles in 2020 on PubMed. It is demonstrated by the rapidly increasing number of publications on the topic as well as the broad scope of topics explored. The need to understand the various topics involving screen media use has never been so urgent. An exploration of current topics in screen media use research is warranted to better understand what has and has not been studied.

In this current study, we applied topic modeling to the large body of published research on screen media use among children and adolescents to determine the key topics that have been studied regarding screen media use.

METHODS

Databases

PubMed®, Scopus®, CINAHL, APA PsycInfo®, and EconLit.

Search Strategies

The following search terms and Boolean combinations were used in the literature search of screen media use among children and adolescents published in English between January, 1st, 1920 and June, 17th, 2020.

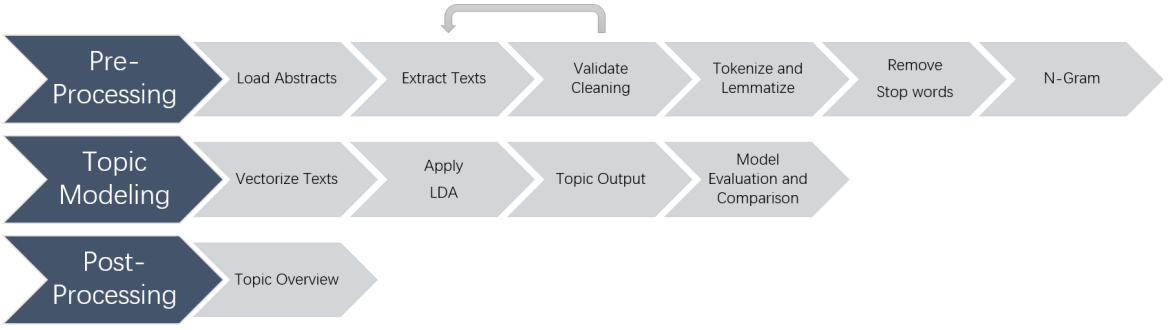
Screen Media				Children and Adolescents
Terms searched in Title/Abstract/Keywords		Terms searched in Title		Terms searched in Title/Abstract/Keywords
"screen time" OR "screen use" OR "screen media" OR "social media" OR "digital media" OR "digital screen"	OR	Internet OR television OR computer OR smartphone OR "mobile phone" OR "cellular phone" OR "mobile device" OR "electronic device" OR "web browsing" OR "screen viewing" OR "social networking site" OR "video game" OR "computer game" OR "internet game"	AND	adolescen* OR child* OR teen*

* use truncation

Structured and Unstructured Abstracts

The records were classified into structured abstracts and unstructured abstracts by matching keywords with specific formats,

Analytical Approach

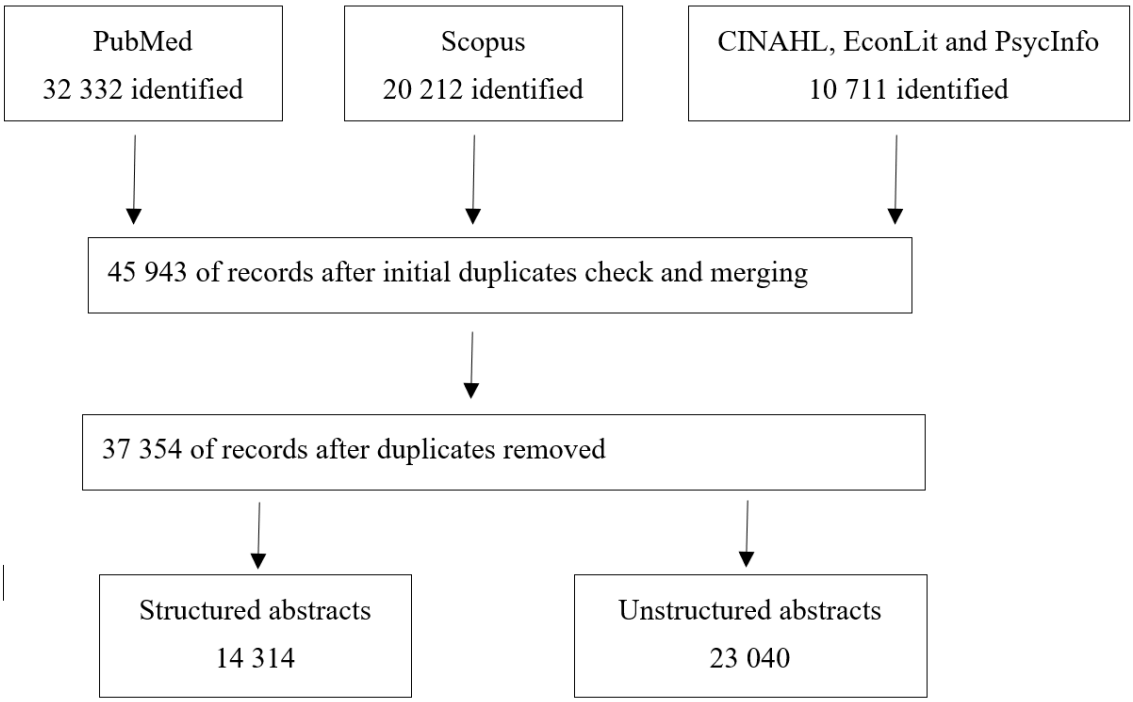


Topic Evaluation

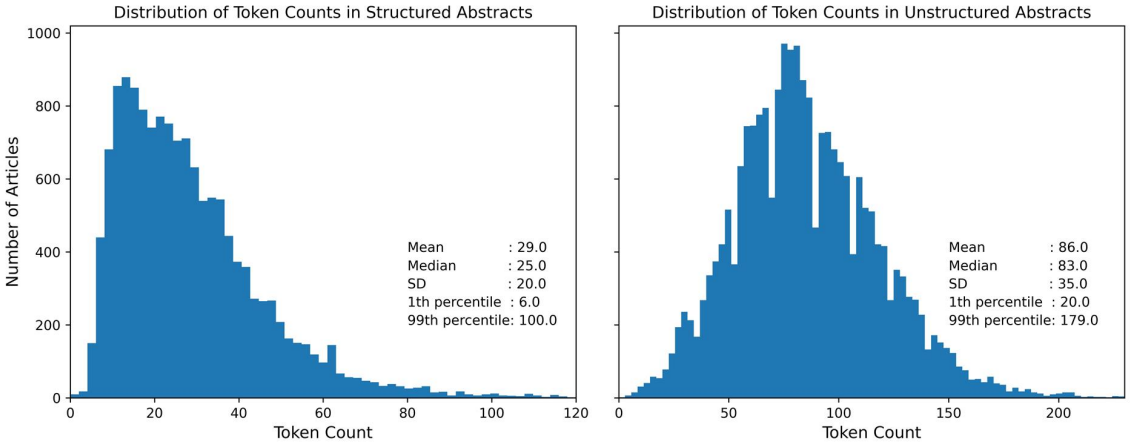
Three evaluators independently evaluated the top 20 words of each topic and summarize the topic. A random sample of 100 abstracts was selected from the topic of which the evaluators were not in agreement and was given to an arbitrator for a final verdict. The titles, the objectives of structured abstracts, word clouds for those topics, and the whole abstract for unstructured abstracts were presented in the discussion to achieve consensus.

SUMMARY OF ABSTRACTS

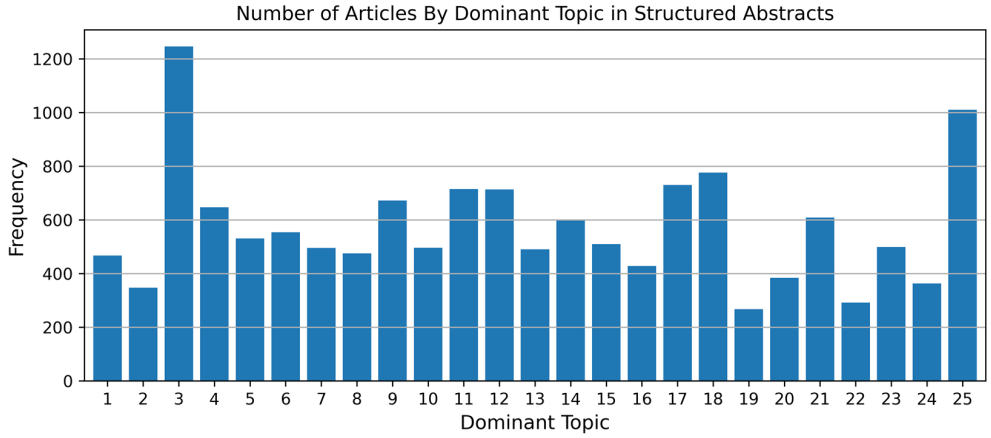
Results of the search of screen media use among children and adolescents published in English between January, 1st, 1920 and June, 17th, 2020.



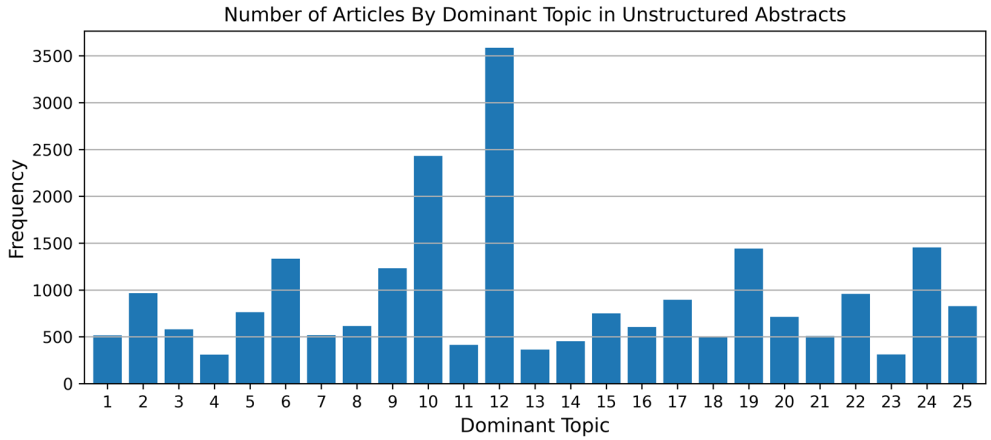
Distribution of token counts in structured abstracts and unstructured abstracts after stop words removal.



Number of articles per dominant topic in structured abstracts

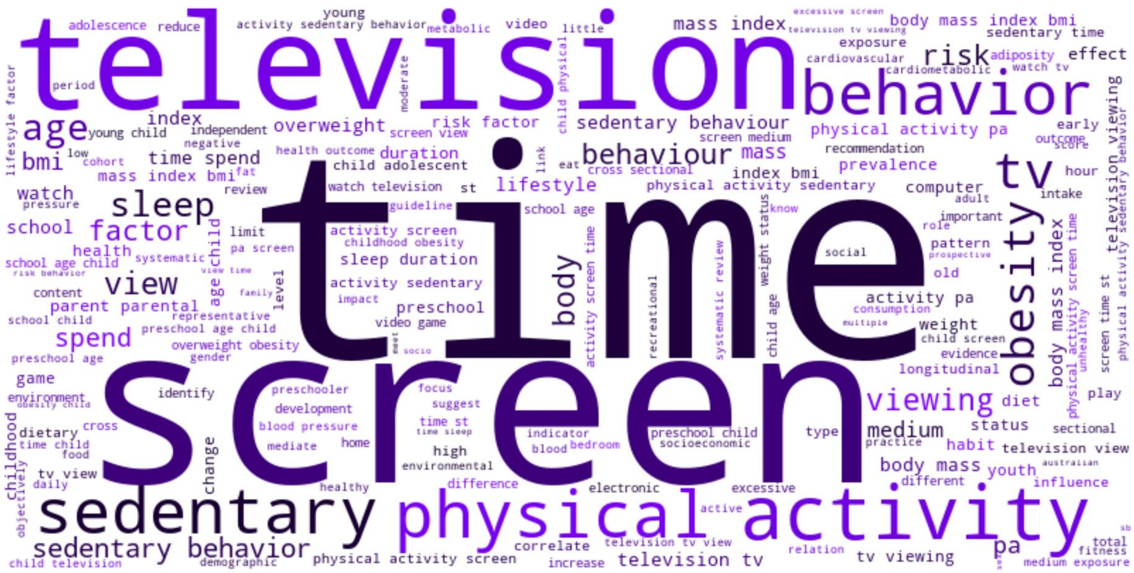


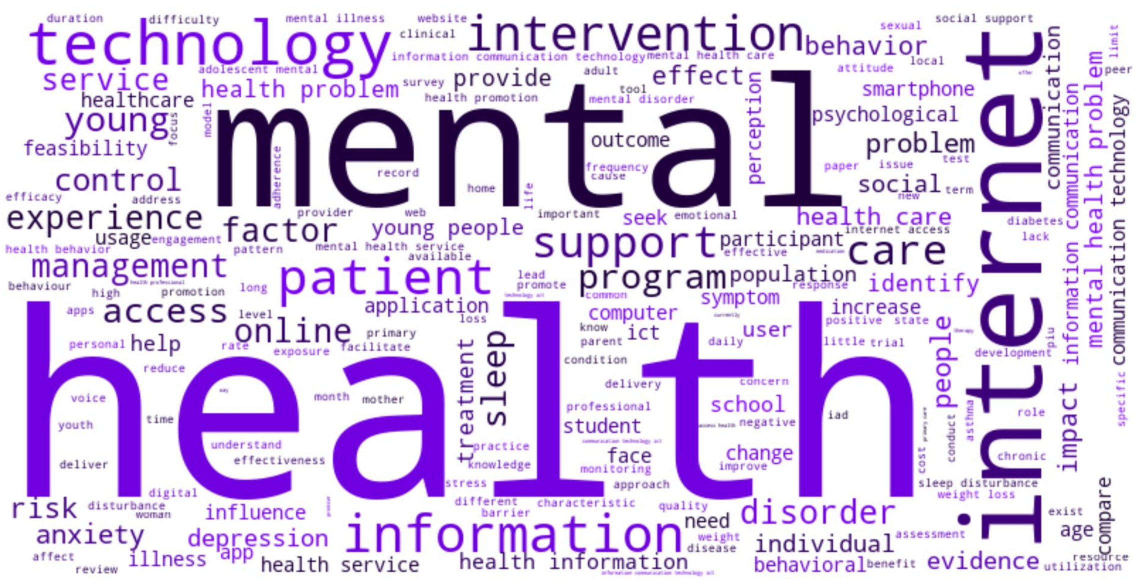
Number of articles per dominant topic in unstructured abstracts



TOPIC MODELING

Examples of word clouds from selected topics of structured abstracts: Topic 3 and Topic 9



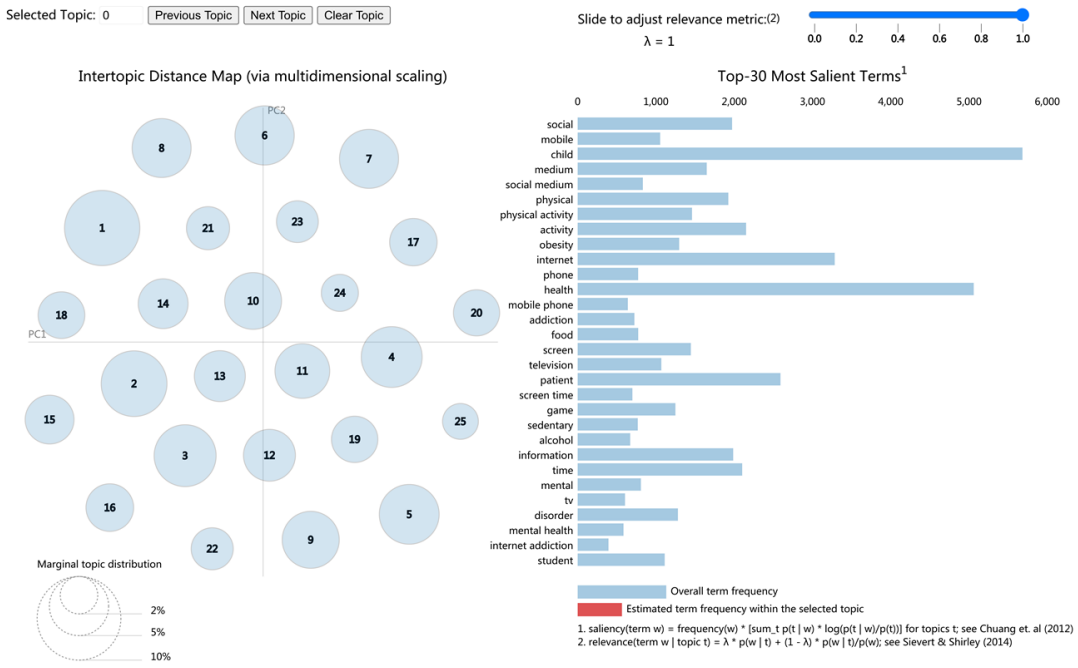


*Words excluded for visualization: child, adolescent, “screen time” and “physical activity”, “mental health”.

Common topics identified by the structured abstracts and unstructured abstracts

Topic Label	Structured Abstract	Unstructured Abstract	Cluster Size
Use of social media platforms for health information and communication	Topic 14, Topic 7	Topic 12	4,678
Screen media use and health behaviors	Topic 3	Topic 24	2,701
Computer-assisted intervention for diagnosis and treatment	Topic 25	Topic 4, Topic 5, Topic 18	2,582
Internet addiction or video game addiction	Topic 20	Topic 6	1,718
Online health information seeking (e.g., vaccine)	Topic 15	Topic 17	1,406
Food advertisement on screen media	Topic 8	Topic 16	1,079

A snapshot of the interactive visualization of the intertopic distance maps and relevant terms for each topic using structured abstracts



TOPIC OVERVIEW

Based on the number of articles in the clusters, the top 5 clusters using structured abstracts were

1. screen media use and health behaviors (e.g., physical activity, obesity, and sleep) (Topic 3)
2. computer-assisted diagnosis and treatment in the pediatric population (Topic 25)
3. internet delivery of therapy for children (e.g., internet-based cognitive therapy) (Topic 17)
4. internet addiction and HIV risk behaviors and interventions (Topic 12)
5. mental health (Topic 9)

The least explored topics in structured abstracts were

1. screen media for dietary management (Topic 19)
2. healthcare-related screen media use for injury rehabilitation (Topic 2)
3. problematic internet use (Topic 20)
4. video gaming in children with autism spectrum disorder (ASD) (Topic 16)
5. healthcare-related screen media use for treatment and medication adherence (Topic 1)

The top 5 clusters in unstructured abstracts were

1. the use of social media for health communication among adolescents (Topic 12)
2. Television viewing among children and their parents (Topic 10)
3. screen media and health behaviors (Topic 24)
4. computer-aided imaging in healthcare (e.g., surgical procedure) (Topic 19)
5. internet addiction (Topic 6).

The least common topics identified were

1. medical imaging technology for computer-aided diagnosis (e.g., tumor detection) (Topic 4)
2. web information and young people’s body image concerns (Topic 11)
3. healthcare-related screen media use for seizure (Topic 18)
4. sexual behavior and sexual experience of children and adolescents in the online environment (Topic 1)
5. screen media use and adolescent sexuality (Topic 7)

Two special populations were highlighted in researches on screen media use: children with autism spectrum disorder (ASD) and children with attention deficit hyperactivity disorder (ADHD).

CONCLUSION AND FUTURE WORK

This study confirmed that natural language processing and unsupervised topic modeling are well-suited for exploring and summarizing large volumes of scientific literature on screen media use among children and adolescents.

Overall, the research topics are diverse and covered many areas, such as health behaviors, health intervention, education and learning, social development, and sexual and reproductive health.

While extensive research has been conducted on screen media use, our findings suggest some unexplored areas. We did not identify any topics related to racial/ethnic disparities, nor did we identify any topics on the economic impact of screen media use. Given the high prevalence of screen media use among children and adolescents, researches on its societal impact are needed.

Our study highlighted the importance of including unstructured abstracts in topic modeling. The results from unstructured abstracts also complemented the results from structured abstracts. We observed that restricting machine learning algorithms to structured abstracts may miss important research work that is being conducted

ABSTRACT

Introduction

In the last several decades, screen-based media have become an integral part of children and adolescents' lives. Yet, there's a lack of a comprehensive list of areas covered by the literature on screen media use among children and adolescents. This study aimed to provide a comprehensive summary of topics in this field using machine learning techniques.

Methods

Structured and unstructured abstracts of relevant scientific literature were obtained from PubMed, Scopus, CINAHL, PsycINFO, and EconLit. Topic modeling, an unsupervised machine learning method in natural language processing, was implemented to derive clusters of research topics from these abstracts.

Results

The search yielded a total of 37 354 records, of which 14 314 were structured abstracts and 23 040 were unstructured abstracts. We identified 25 topics from structured abstracts and unstructured abstracts separately. Based on the number of articles in each topic, the highly researched topics were the use of social media platforms for health information and communication, screen media use and health behaviors (e.g., physical activity, sleep, smoking, eating, etc.), and computer-assisted intervention for disease diagnosis and treatment. The least explored topics were dietary management, healthcare-related screen media use for injury rehabilitation, and web information and body image concerns.

Conclusion

Our study confirms the feasibility of using topic models to derive a comprehensive summary of research on screen media use among children and adolescents. While extensive research has been conducted, our findings suggest some unexplored areas, such as racial/ethnic disparities and the economic impact of screen media use.

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