Semantic network analysis in consumer and marketing research: application areas in phygital contexts

Jonathan David Schöps

Stockholm Business School, Stockholm University, Stockholm, Sweden, and

Philipp Jaufenthaler

Department of Management and Marketing,
University of Innsbruck, Innsbruck, Austria

Abstract

Purpose – Large-scale text-based data increasingly poses methodological challenges due to its size, scope and nature, requiring sophisticated methods for managing, visualizing, analyzing and interpreting such data. This paper aims to propose semantic network analysis (SemNA) as one possible solution to these challenges, showcasing its potential for consumer and marketing researchers through three application areas in phygital contexts.

Design/methodology/approach – This paper outlines three general application areas for SemNA in phygital contexts and presents specific use cases, data collection methodologies, analyses, findings and discussions for each application area.

Findings – The paper uncovers three application areas and use cases where SemNA holds promise for providing valuable insights and driving further adoption of the method: (1) Investigating phygital experiences and consumption phenomena; (2) Exploring phygital consumer and market discourse, trends and practices; and (3) Capturing phygital social constructs.

Research limitations/implications – The limitations section highlights the specific challenges of the qualitative, interpretivist approach to SemNA, along with general methodological constraints.

Practical implications – Practical implications highlight SemNA as a pragmatic tool for managers to analyze and visualize company-/brand-related data, supporting strategic decision-making in physical, digital and phygital spaces.

Originality/value – This paper contributes to the expanding body of computational, tool-based methods by providing an overview of application areas for the qualitative, interpretivist approach to SemNA in consumer and marketing research. It emphasizes the diversity of research contexts and data,

All authors contributed equally to this paper and should be regarded as joint first authors.

Co-first authors can prioritize their names when adding this paper's reference to their resumes.

where the boundaries between physical and digital spaces have become increasingly intertwined with physical and digital elements closely integrated – a phenomenon known as phygital.

Introduction

The analysis of language plays a pivotal role in consumer and marketing research (Packard and Berger, 2023). Traditionally, researchers have used various text-based methods, such as interviews, open-ended survey questions and association tasks, to gain a deeper understanding of consumers. The emergence of social media platforms, big data, and the appification of services has not only profoundly expanded the realm of text-based consumer-generated data (Klostermann *et al.*, 2018) but also blurred the boundaries between physical and digital environments (Batat, 2022). This blurring has given rise to environments that integrate "physical, human, digital, and media content elements, platforms, technologies, and extended realities" (Batat, 2022: 10) – phygital environments. In this confluence of the physical and digital, social media serves as a bridge, enabling users to translate their real-world experiences onto digital platforms (Schöps *et al.*, 2024), thus creating complex networks of phygital interactions. User-generated content on social media introduces a digital layer to physical experiences, as these shared narratives and visual stories infuse digital spaces with elements of the tangible world. Conversely, the digital feedback loop influences physical experiences, as real-world actions, representations and choices are often shaped by digital interactions, trends and community engagements (Beichert *et al.*, 2024), further blurring the lines between these realms.

Traditional data analysis methods, such as manual content analysis, often struggle to account for the intertwined nature of physical and digital elements, as well as their size and scope. It is, therefore, unsurprising that computational methods, such as automated text analysis (ATA) and semantic network analysis (SemNA), have gained notable attention recently. These methods facilitate the analysis of the nature, size and scope of unstructured, large-scale text-based data. ATA (Berger *et al.*, 2020, 2022) quantifies unstructured, large-scale text-based data, enabling researchers to test "the relationship between or amongst the constructs or variables of interest" (Humphreys and Wang, 2018: 1275). SemNA, a related yet distinct approach, centers on the visualization, exploration and analysis of "the web of meaning" (Doerfel, 1998: 17) or the "networks of interrelated conceptual units" (Lehmann, 1992: 1) in text-based data. This method facilitates the integration of both quantitative elements, such as numeric measures of semantic units and their co-occurrences, and qualitative components, involving the visualization and interpretation of the relationships in semantic networks (Rice, 2005).

In phygital contexts, exploring, understanding and accounting for the nature, scope and relationships between physical and digital elements is particularly crucial. This study introduces SemNA as both a tool and a solution for researchers navigating these complex phygital domains of consumer and marketing research. Despite existing work in related fields that outlines the procedural steps for SemNA (Christensen and Kenett, 2021; Segev, 2021) – enabling its replicability in other fields – a notable gap exists in guidance on *when*, *where* and *how* to apply it in consumer and marketing research unfolding in contemporary phygital contexts. This lack of detailed guidance is a major barrier to the method's adoption and effective utilization in the field. Accordingly, identifying and addressing these areas are

essential steps toward broadening the application and impact of SemNA in consumer and marketing research.

This paper proposes three application areas, accompanied by exemplary use cases, for SemNA within phygital contexts, targeting consumer and marketing research. The first application area uses SemNA to explore the complex relationships between digital and physical consumption practices. This is illustrated by an analysis of narrative interviews in which respondents were immersed in the digital space of Instagram, serving as a stimulus for reflective accounts of the interplay between digital fashion content consumption and its impact on physical fashion consumption. The second application area uses SemNA to investigate the phygital nature of social media discourse, trends and practices. This is illustrated through an examination of the #sustainability discourse, revealing its manifestation as a product of both digital affordances and physical consumption practices. The third application area uses SemNA to convert social constructs of phygital nature into tangible and intuitive digital representations. This is exemplified by illustrating how mental associations with Cristiano Ronaldo are composed of his physical achievements and his social media persona. Accordingly, this paper contributes to "the growing need for methodologies that incorporate analysis of textual data in consumer [and marketing] research" (Humphreys and Wang, 2018: 1296). We provide an overview of each application area encompassing purposes, benefits, challenges, exemplary research questions and data sources, thereby showcasing its potential and versatile application across textual data in phygital contexts.

Theoretical background
Computational text analysis methods in consumer and marketing research
Computational text analysis methods are increasingly used in consumer and marketing research for large-scale text analysis and natural language processing. These methods encompass, for example, dictionary-based text analysis, word embedding models, topic modeling (Berger *et al.*, 2022) and SemNA (Caliandro and Gandini, 2017), which differ in their approaches and outputs. Dictionary-based text analysis relies on predefined categories or dictionaries. Linguistic inquiry and word count, for example, categorizes words into various emotional, cognitive and structural components and outputs a quantitative analysis showing the frequency or presence of certain categories of words (Berger *et al.*, 2022). Word embedding models "learn semantic representations from word co-occurrence patterns in natural language" (Berger *et al.*, 2022: 370), and output a set of vector representations for words. Instead of explicitly mapping relationships between concepts, these models encode relationships within a multidimensional space, where each word is represented as a vector. Topic modeling is a statistical method that identifies topics present in a corpus of text and outputs a set of topics, each represented as a collection of terms and a distribution of these topics within each document. As such, topic modeling provides statistical insights into the prevalent themes in the text (Berger *et al.*, 2022) but does not capture the explicit relationships between words. In contrast, SemNA focuses on visualizing "set[s] of connected semantic relations" – paths – that "can be analyzed qualitatively to reveal different semantic relations that connect words in the semantic network" (Drieger, 2013: 7, 10). This approach enables a more nuanced exploration of the relationships and representations of concepts within textual data.

Key elements of semantic network analysis
SemNA has been developed across multiple disciplines over the past few decades (Danowski, 1988). While early accounts focused on the ontology and grammar of words,

the paradigmatic focus shifted from the "grammatical function of words" to "the study of the relationships between words, concepts, and meanings" (Segev, 2021: 5). As such, SemNA focuses on the visualization and analysis of "meaning networks" (Doerfel, 1998: 24), assessing "the extent to which words are related, which indicates something about their meaning" by "the extent to which word pairs co-occur within a given meaning unit" (Rice, 2005: 288). This "underlying co-occurrence metric helps to identify groups of [words] that are strongly connected and therefore represent underlying topics" (Klostermann *et al.*, 2018: 553), which can then be explored in-depth through subsequent qualitative, interpretivist work.

Semantic networks are based on three fundamental elements:

(1) Nodes;
(2) Edges; and
(3) Modularity classes.

Nodes, depicted as circles, serve to "represent semantic or lexical units" (Christensen and Kenett, 2021: 860). The nature of these semantic units within the network is task-dependent, encompassing distinct concepts or entities. Specifically, these units can be words, phrases or other identifiable meaning-bearing units, such as "category exemplars (verbal fluency), associations to cue words (free association), or cue words whose similarities are rated (similarity judgments)" (Christensen and Kenett, 2021: 860). Edges, represented as lines, indicate "the similarity, co-occurrence, or strength of the associations between them [nodes]" (Christensen and Kenett, 2021: 860). When analyzing relationships among semantic units, it is important to define the window size, representing the maximum distance within which two semantic units are considered to co-occur within a text (e.g. a window size at the sentence level only connects semantic units within each sentence). A node's degree – its centrality in the network – is calculated by the total number of edges connected to it. The third central element, modularity classes, is based on an algorithm that iteratively groups nodes into thematic communities in a way that maximizes the modularity of the partition, i.e. the strength of the division of the network into communities (Blondel *et al.*, 2008). This strength is determined by the modularity score (range: 0 to 1). The higher the value, the more distinct and well-defined these communities are, i.e. the stronger the community structure (Brandes *et al.*, 2008). When calculating modularity, the resolution parameter, which influences the sensitivity of the algorithm to community detection, can be adjusted. A high resolution favors detecting smaller, and a low resolution larger communities. Notably, no universally correct resolution value exists; it needs to be adjusted to the nature of the data (Bruns and Snee, 2022). Table 1 provides an overview of these three central elements, including their descriptions, measurements and visual representations.

Approaches to semantic network analysis in consumer and marketing research
In consumer and marketing research, two approaches to SemNA have recently developed – a quantitative and a qualitative, interpretivist approach. Both approaches share common ground in their use of SemNA to investigate and analyze the complex nature of unstructured, large-scale text-based data, transforming it into structured analysis that reveals the nuanced interplay of themes, patterns and relationships. The quantitative approach systematically uses text-mining techniques and network analysis tools to measure structural characteristics of semantic networks, such as graph density, centrality measures and clustering coefficients. This approach enables the extraction of quantifiable information from large data sets, facilitating rigorous, replicable analyses that offer insights into

Element (synonyms)	Description	Measure unit	Network visualization representation
Node (actors and vertices)	*Semantic unit or concept* that represents a unique element in the semantic network (Christensen and Kenett, 2021)	*Degree* Describes the centrality/significance of the node within a network and is measured by counting the total number of edges connected to a node	*Circle* Its size depends on the calculated degree of the respective node
Edge (links, ties and connections)	Describes the *co-occurrence* of two or more semantic units/concepts, indicating the relationship, similarity or strength of the associations between two or more nodes (Christensen and Kenett, 2021)	*Weight* Represents the strength of the relationship between connected nodes and is typically determined by the frequency of the co-occurrence	*Connecting line* Its thickness depends on the weight of the edge
Modularity classes (clusters and communities)	The outcome of an algorithmic process that compartmentalizes a network into thematic *subnetworks* based on densely connected nodes within the network (Segev, 2021)	*Percentage size* Describes the size of a respective modularity class relative to the entire network	*Distinct node colors* Each *subnetwork* is uniformly colored

Source: Author's own work

Table 1.
Key elements of semantic network analysis

phenomena like market structures and consumer behaviors. Studies such as those by Teichert and Schöntag (2010), Netzer *et al.* (2012) and Ko *et al.* (2015) exemplify this approach by quantifying perceptual associations and exploring relationships between concepts such as shopping and mood alleviation, respectively.

Conversely, the qualitative, interpretivist approach integrates SemNA as a tool for initial data structuring, followed by data-driven, interpretivist exploration and theorization (Lucarelli *et al.*, 2023) of thematic clusters and relationships, delving into the sociocultural intricacies and dynamics revealed by the network analysis (Caliandro and Gandini, 2017) – largely within digital and phygital contexts. For example, Schöps *et al.* (2020, 2022, 2024) use SemNA to visualize and interpret semantic discourses on Instagram, exploring how hashtags influence consumer discourse and the structure of digital market networks.

In this paper, we focus on the qualitative, interpretivist approach, highlighting SemNA as a promising method for consumer and marketing researchers to explore various phenomena across phygital contexts (Batat, 2022). Phygital contexts, characterized by the interplay between digital and physical interactions (Mele and Russo-Spena, 2022), demand tools capable of grasping this interplay, generating insights, for example, into the relationship between physical experiences and online discourses. Moreover, the complexity and intertwined nature of data in phygital contexts require methods that can be adapted to diverse text-based data sets and incorporate both quantitative and qualitative elements to enable sophisticated analysis and in-depth interpretations. As SemNA enables the visual mapping of semantic units through computational text analysis, revealing word/concept relationships, thematic clusters and thereby facilitating the qualitative exploration of knowledge, information, concepts and meanings in text-based data, we propose it as a method particularly suited for phygital contexts.

Application areas for semantic network analysis in phygital contexts

In the following sections, we present three application areas for SemNA in phygital contexts:

(1) Investigating phygital experiences and consumption phenomena;
(2) Exploring phygital consumer and market discourse, trends and practices; and
(3) Capturing phygital social constructs.

The selection of these application areas stems from their direct relevance to the current challenges in understanding consumer behavior within rapidly evolving phygital landscapes. Each area represents a critical facet of consumer and marketing research, where SemNA can offer valuable insights into the complex interplay of digital and physical realms. Through exemplary use cases for each area, we demonstrate the versatility of SemNA and its potential for qualitative, interpretivist consumer and marketing research in phygital contexts. Additionally, Figure 1 provides an overview of the proposed application areas for SemNA in consumer and marketing research, detailing its distinct purposes, benefits, challenges and offering exemplary research questions and data sources for future research.

Application area 1: investigating phygital experiences and consumption phenomena
Contemporary consumption phenomena are increasingly unfolding at the intersection of physical and digital realms, with social media acting as a critical mediator that connects these two spaces. This dynamic interplay renders consumption experiences inherently phygital – the digital sharing of personal experiences on platforms such as Instagram intersects with, and profoundly influences, physical consumption (Batat, 2022). Within this context, investigating consumer narratives of phygital experiences and consumption offers rich insights into their behaviors, preferences and identities. Traditional qualitative data

Semantic Network Analysis

The visual mapping of semantic units through computational text analysis, revealing word/concept relationships, thematic clusters, and thereby facilitating the qualitative exploration of knowledge, information, concepts, and meanings in text-based data

Application Areas in Consumer and Marketing Research

Application Area 1: Investigating Phygital Experiences and Consumption Phenomena	**Application Area 2: Exploring Phygital Consumer and Market Discourse, Trends, and Practices**	**Application Area 3: Capturing Phygital Social Constructs**
<u>Purpose</u> Exploring the complex relationships between digital content consumption and physical consumption practices	<u>Purpose</u> Analyzing the emergence of contemporary consumption trends and practices disseminated through social media	<u>Purpose</u> Rendering abstract phenomena into tangible and intuitive digital representations, thereby enabling a deeper understanding of their composition
<u>Benefits</u> -Visualization of consumer narratives of phygital experiences and consumption -Uncovering the web of interactions between physical and digital consumption spaces -Enhanced insights into consumer journeys	<u>Benefits</u> -Realtime mapping of digital consumer discourse -Detection of changing and emerging market understandings and shifts in consumer behavior -Identification of emergent consumption practices	<u>Benefits</u> -Illustrative mental snapshot of abstract concepts -Facilitating explorations of phygital phenomena -Enabling cross-context comparisons -Applicable to various social constructs
<u>Challenges</u> -Access to diverse data sources -Interpreting the fluidity of consumer experiences across digital and physical realms -Interpreting large networks -Ambiguity in language	<u>Challenges</u> -Continuously changing API access points on social media -The need for IT, software, and coding expertise -Ethical considerations: anonymity, and handling public vs. private content	<u>Challenges</u> -Requiring a critical mass of participants/data, varying with the complexity of the social construct under study -Varied data cleaning needs influenced by data quality, use case, and participant sample
<u>Exemplary Research Questions</u> -How do online consumer reviews influence the physical consumption practices? -How does the integration of augmented reality in retail environments influence consumer decision-making processes? -How do YouTube tutorials influence product usage?	<u>Exemplary Research Questions</u> -How do consumers express a distinct lifestyle/product category/consumption practice using text-based affordances? -How do companies/brands use video content to engage with their audiences on TikTok? -What language do consumers employ on digital platforms to narrate their physical practices?	<u>Exemplary Research Questions</u> -How do consumers perceive the brand X? How are those perceptions influenced by physical/digital interactions? -How do perceptions of X [e.g., brand, person, location] differ across diverse generational/cultural/lifestyle segments with distinct digital behaviors?
<u>Exemplary Data Sources</u> -Interviews -Social media posts, brand mentions, or customer reviews related to phygital experiences and consumption -Diaries	<u>Exemplary Data Sources</u> -Consumer-generated content -Consumer comments/discourse (YouTube, Instagram, X, TikTok, Facebook, forums) -Hashtags (Instagram, X, TikTok)	<u>Exemplary Data Sources</u> -Free association tasks -Phenomenon-centric essays or logs -Open-ended survey questions

Source: Author's own work

analysis techniques and even modern coding software such as NVivo, which outputs word counts and weighted word percentages, fall short in uncovering the Web of interactions and influences between physical and digital consumption spaces inherent to such phygital consumption phenomena. In this first application area, we showcase how SemNA transcends these limitations by providing a more nuanced understanding of phygital experiences and consumption practices through the visualization of the prominence and interconnectedness – i.e. word pair centralities and relationships – of concepts in phygital data.

Use case. As a use case, we chose to investigate consumers' identity projects related to fashion consumption on Instagram. This use case explores the phygital interplay between digital content consumption on Instagram, e.g. influencer-driven advertorials and its impact on consumers' physical fashion consumption and identity evolution.

Sample and procedure. We conducted narrative interviews supplemented with auto-driven photo elicitation (Heisley and Levy, 1991) in October 2022. The interviews were structured around a guideline encompassing three major sections: storytelling about:

(1) The role of fashion and Instagram in interviewees' everyday life;
(2) The selected accounts (projective material); and
(3) The role of Instagram in interviewees' own fashion consumption.

We used a purposive sampling strategy, requiring interviewees to not only have an Instagram account but also to actively follow fashion-related accounts. Interviewees were asked to select two fashion-related accounts of their choice, which served as projective material. The sample comprised 15 European interviewees (M_{age} = 24 years; 80% female). The interviews lasted from 40 min to 1h 40 resulting in 174 pages of *verbatim* transcripts.

To prepare the transcripts for subsequent ATA and SemNA, we removed all interviewer questions. We then used Wordij 3.0 (Danowski, 2013a) to conduct an ATA. The settings for the ATA included a stop word list (Humphreys and Wang, 2018), which eliminated words such as "I," "you," "because" and "example" from the data set. Additionally, words and word pairs that occurred fewer than two times were excluded, word pair order was not preserved, the window size was set to 10 at an intersentential level (Danowski, 2013b), English contracted forms were expanded and numbers and punctuation within words were removed.

This procedure resulted in 858 unique words (nodes) and 10,576 connections (edges) between the words. We then used Gephi (Bastian *et al.*, 2009) to calculate the degree, and run the modularity algorithm (resolution: 1.0; modularity score: 0.206) for community detection (Brandes *et al.*, 2008). To improve readability, we filtered out words with a degree below 10, resulting in visibility for 58.16% of nodes (499 words) and 80.56% of edges (Figure 2).

Findings. Community detection identified three clusters – the purple cluster accounting for 38.23%, the orange cluster for 31.12% and the green cluster for 30.65%. The purple cluster contains narratives about the role of fashion and Instagram in interviewees' fashion consumption. The words with the highest degree in this cluster are "fashion" (416), "style" (288), "clothes" (275), "wear" (270), "brands" (261), "nice" (250), "buy" (212) and "trends" (180) – core aspects of interviewees' fashion discourse. In-depth analysis of this cluster further reveals a dense network of connections among the words "fashion" (416), "style" (288), "young" (28), "older" (13), "age" (18) and "change/d" (117), forming paths of relationships that connect the concepts of "fashion" and "identity." The data reveals various narrative paths constructed by consumers to articulate the transformation of their identities and fashion preferences over time.
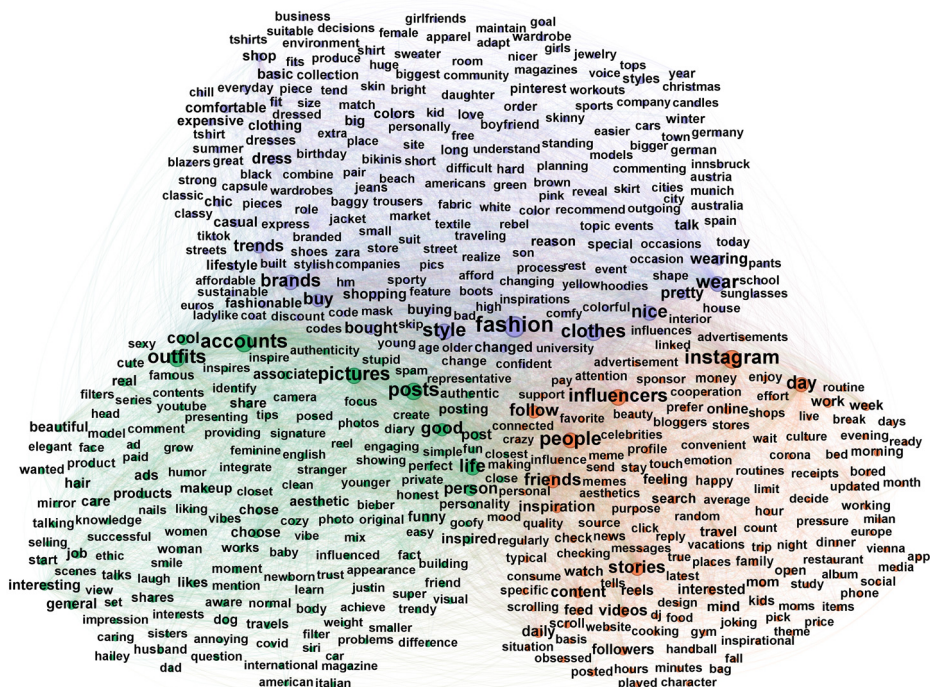
Source: Author's own work

One such path exemplifying the interconnectedness of these concepts is represented by the following quote:

> I've changed since I'm studying, going to university. My style changed a lot. Before, in school, it was really different. And I think with growing older, you know more who you are. You find yourself, and maybe are more okay with yourself. Because when you're younger (...), I think you're struggling sometimes. (...) you do not know your identity that well.

The orange cluster encapsulates narratives about the role of Instagram in interviewees' daily interactions with the platform. The words with the highest degree in this cluster are "instagram" (344), "influencers" (290), "people" (273), "day" (252), "stories" (221), "friends" (214), "follow" (201), "videos" (142) and "content" (131). SemNA further uncovers a network of connected semantic relationships between "instagram" (344), "day" (252), "work" (111), "morning" (48), "bored" (43), "evening" (28), "bed" (26), "break" (20) and "routine" (13), forming paths that illuminate how daily digital routines on Instagram seamlessly intersect with and shape physical activities, from work habits to leisure, showcasing the phygital nature of contemporary lifestyle integration. The following quote exemplifies this:

> A typical situation would be in the morning after I wake up. Then, a lot of times I use it when I'm at work (...). In my lunch break (...), in my coffee break. After work, when I'm cooking, (...) when I'm eating dinner, and before I go to bed, so all day long. But typical situations would be when I don't, um, exactly have like when I'm not in a rush.

The green cluster encompasses narratives about the projective material. The words with the highest degree in this cluster are "accounts" (327), "posts" (314), "outfits" (294), "pictures" (279), "life" (260), "good" (204), "person" (171), "cool" (143) and "post" (103). A deeper analysis of the semantic network reveals paths interconnecting the words "accounts" (327), "posts" (314), "pictures" (279), "outfits" (294), "life" (260), "authentic" (51), "perfect" (48), "private" (28) and "honest" (24), illustrating the words and concepts that interviewees relate when talking about digital content and creators, and the qualities they find relatable:

> I like her because she appears to be authentic and she puts a lot of work into her posts, which I really appreciate. Also, unlike many other influencers, her accounts only focus on fashion, which means she keeps her private life mostly out of it. Additionally, her style heavily resembles mine, so I can really identify with her.

However, our analysis also reveals that interviewees connect these terms to the potential negative impacts of digital content consumption on the perception of physical reality. The following quote, while initially anchored to the same node, i.e. "authentic," diverges in its narrative path. That is, the first quote forms a path of relationship between "authentic" and "identity"; the following one between "authentic" and "reality." This contrast underscores how the relationships between specific words, and consequently their meanings, can vary substantially among individuals. The following quote exemplifies this variation:

> (. . .) when I'm saying that they are authentic and honest and things like that, I know that they are trying to present themselves from their best side. It is also a dangerous platform, especially for younger people, because there is often the urge to compare yourself with those influencers and ask yourself why you don't have a life like them. So, you shouldn't lose reality and know that their life is not always as perfect as they portray it to be.

This connection between digital content's perceived authenticity and consumers' perception of physical reality underscores a phygital interaction, where digital narratives directly affect offline self-concept and fashion consumption practices. This dynamic also illustrates a considerable phygital challenge, highlighting how the digital world's pressures and ideals can affect individuals' self-esteem and consumption practices in the physical world. Accordingly, the complex interplay between digital engagement and physical behaviors reveals the profound influence of social media narratives on personal identity and consumption lifestyles.

 Discussion application area 1. This use case demonstrates the suitability of SemNA in the study of phygital phenomena. Its ability to identify and visualize thematic clusters and the relationships between them provides a nuanced lens through which the complex interplay between digital content consumption and physical consumption practices – in our case, digital fashion content and related offline fashion consumption – becomes deeply insightful. The specific insights gained offer a holistic overview of phygital consumer journeys and the broader implications of phygital experiences and consumption phenomena, showcasing how digital consumption is linked to and impacts offline consumption. SemNA thus facilitates the unraveling of the complexities of phygital interactions which can substantially enrich subsequent interpretivist work (Lucarelli *et al.*, 2023).

Application area 2: exploring phygital consumer and market discourse, trend and practices
Digital environments are teeming with diverse text-based data, where language is platform-specific. Each platform "comes to have its own unique combination of styles, grammars, and logics, which can be considered as constituting a 'platform vernacular'" (Gibbs *et al.*, 2015: 257). This vernacular is shaped by platforms' affordances (Caliandro and Anselmi, 2021). A prevalent text-based affordance in digital environments is the hashtag, which users leverage

to frame discursive spaces – referred to as issue spaces (Marres, 2015) – using a specific issue language, such as #blacklivesmatter or #climatechange. Essentially, this process transfers issues from the physical to the digital world, rendering these issues phygital. In marketing contexts, hashtags help frame a "market-embedded and market-related social issue into platform jargon" (Schöps *et al.*, 2022: 79). However, given the vast volume and complex nature of digital data, even specialized qualitative methods like netnography (Kozinets, 2020), developed for social media research, may not fully capture the breadth and depth of digital interactions and the related cultural dynamics. This oversight can leave critical patterns and trends in the data unexplored, which could otherwise enrich subsequent interpretivist work. In this second application area, we demonstrate how SemNA addresses these limitations by visualizing the relationships within the language of these phygital market spaces.

Use case. As a use case, we chose to illustrate consumer-generated discourse, trends and practices within the issue space of #sustainability on Instagram. Our analysis focuses on hashtags that co-occur with #sustainability in consumer captions. Sustainability is a contemporary hot topic with pervasive relevance across societies and industries.

Sample and procedure. We collected a data set comprising metadata from 1,000 Instagram posts tagged with "#sustainability" in February 2023, using the InstaCrawlR scripts in RStudio for targeted data extraction (Schröder, 2018). The metadata includes elements such as post URLs and captions with hashtags. Using a custom Python script, we set the window size at the post level to pair all hashtags within each post, and then compiled this data into a comma separated values file for analysis. This file was subsequently imported into Gephi (Bastian *et al.*, 2009; Gephi, 2024), where we calculated network statistics and visualized the semantic network of hashtags. Specifically, we calculated the degree and ran the modularity algorithm (resolution: 1.0; modularity score: 0.636) for community detection (Brandes *et al.*, 2008). The resulting network contains 7,656 nodes, representing unique hashtags and 114,202 edges. To improve readability, we filtered out hashtags with a degree below 40, resulting in visibility for 11.79% of nodes and 17.4% of edges (Figure 3).

Findings. SemNA identified nine distinct clusters of densely connected hashtags, each representing a unique aspect of the #sustainability discourse. The purple cluster (15.14% of the semantic network) is characterized by general sustainability buzzwords, e.g. #sustainable (degree: 1,855), #ecofriendly (1,635) and #sustainableliving (1,540). The red cluster (7.77%) focuses on sustainable nutrition and food culture, featuring hashtags like #organic (449) and #plantbased (300). The dark gray cluster (6.66%) features hashtags that illustrate consumption practices related to #sustainablefashion (1,309), such as buying #vintage (375), #secondhand (207) and #thriftedfashion (163). The orange cluster (5.57%) is centered around sustainable approaches to #architecture (292) and #interiordesign (404). The blue cluster (4.94%) relates to the #slowfashionmovement (174) seeking a #fashionrevolution (193). The turquoise cluster (4.09%) contains content showcasing #handmade (606) #craftsmanship (73). In the light blue cluster (4%), consumers campaign for #shoplocal (513) and #supportsmallbusinesses (258). The yellow cluster (4.04%) exhibits content related to a #healthylifestyle (186) and #selfcare (175). The light green cluster (2.98%) is focused on #sustainabledevelopmentgoals (93), the green cluster (2.95%) on sustainable #travel (102) content and the pink cluster (2.61%) on #renewableenergy (158), completing the thematic clusters.

Analyzing the relations between semantic units across clusters enables the interpretation of the network's phygital nature. For example, SemNA reveals connections between #slowfashion, #shoplocal, #supportsmallbusinesses, #craftsmanship, #artisan and

Source: Author's own work

#handmade, illustrating a shift toward more sustainable and ethical consumption patterns. By prioritizing slow fashion, consumers advocate moving away from the environmentally harmful and ethically questionable practices of the fast fashion industry toward more sustainably and ethically produced clothing. The emphasis on shopping locally and supporting small businesses highlights a commitment to reducing the carbon footprint from long-distance goods transportation and fostering local economies. Moreover, the focus on craftsmanship and artisanal, handmade products underscores an appreciation for the quality, uniqueness and story behind each item, contrasting with the homogeneity and disposability of mass-produced goods. Together, these connections shed light on consumers' physical consumption practices, which are then shared in the digital environment of Instagram to create awareness and campaign for sustainable consumption. This sharing and promoting of sustainable choices on Instagram exemplifies how physical experiences and consumption practices intertwine with digital activism.

Discussion application area 2. This use case highlights SemNA's utility in exploring the phygital nature of social media discourse, trends and practices – in our case, #sustainability on Instagram. It demonstrates how SemNA provides a comprehensive overview of the intertwined physical and digital elements that constitute social media discourse. This includes a discursive phygital space characterized by digital displays of physical consumption practices enhanced with digital affordances such as hashtags. This holistic

visualization not only uncovers the digital language of the specific discourse but also illuminates related trends and practices in the physical world, as illustrated by the interpretive analysis of the cross-cluster connections. Therefore, this use case showcases how SemNA's capability to produce insightful visualizations that support subsequent interpretivist work (Lucarelli *et al.*, 2023) on phygital consumer and market discourse, trends and practices, such as "changing and emerging market understandings, and [. . .] shifts in consumer behavior" (Schöps *et al.*, 2022: 98).

Application area 3: capturing phygital social constructs
In physical environments, social constructs materialize in people's minds. Researchers have continuously sought to better understand and capture such constructs – abstract concepts without objective meaning that have "been created and accepted by the people in a society" (Merriam-Webster Dictionary, 2024). For example, the mental representation of a brand can be conceptualized as compositional associations triggered when consumers think of the brand (Keller, 1993). In today's phygital world (Batat, 2022; Mele and Russo-Spena, 2022), such representations are typically nurtured by both physical (e.g. experiences and word of mouth) and digital (e.g. social media and websites) channels.

Previous research has often used free association tasks to explore social constructs. Originating in psychology, this approach is based on the understanding that knowledge is stored in associative networks (Anderson and Bower, 1974). Associations are seen as valid indicators of meaning and were already used by Freud (Rozin *et al.*, 2012). Association techniques can be applied in any research on social constructs, e.g. to investigate stereotyped representations of a family business (Jaufenthaler, 2023), or consumers' gender-related representations of meat (Rozin *et al.*, 2012).

To analyze the resulting unstructured data, researchers have used various approaches ranging from simple hand counting to more sophisticated approaches, such as brand concept maps (John *et al.*, 2006) or Vergès matrices (Vergès, 1992). However, these traditional methods have notable limitations, including being time-consuming and providing limited insights, challenges that are more pronounced when dealing with large-scale data sets of complex nature. In this third application area, we argue that SemNA offers a more comprehensive solution by providing snapshots of today's digitally nurtured social constructs in a profound, yet intuitive manner, graphically enabling deeper interpretations by revealing the centrality of nodes, semantic relationships and thematic clusters.

Use case. As a use case, we chose to explore consumers' mental representation of Cristiano Ronaldo – one of the world's most valuable human brands (Forbes, 2022). Ronaldo is a professional football player renowned for his endorsements with global brands, such as Nike, and for winning several prestigious trophies at both the team and individual levels. In 2022, he became the first person to surpass the 400 million followers milestone on Instagram. Therefore, Ronaldo represents an interesting use case to illustrate a phygital social construct where mental associations are an amalgamation of his physical accomplishments on the field and his meticulously crafted social media persona.

Sample and procedure. We conducted a survey among Austrian students in December 2022. Participants were asked to list three to seven associations that came to mind upon hearing "Cristiano Ronaldo," followed by providing their demographic information. A total of 824 participants completed the survey (M_{age} = 24 years; 30% female), and provided 3,180 associations. We engaged in basic preprocessing of the data set. The preprocessing involved cleaning the data set of typos and identifying semantic concepts, which are interrelated terms forming a single concept for analysis, such as "world footballer." Consequently, we removed spaces between such words. We then used Wordij 3.0 (Danowski, 2013a; Wordij, 2024), an

open-source software, for ATA to quantify the frequency of each association and to identify co-occurrences between association pairs. Co-occurrences were only counted within the different associations of a single respondent, necessitating the placement of a period at the end of each association set and setting the window size for the analysis at the sentence level. The applied settings also included a stop word list (Humphreys and Wang, 2018), which eliminated words such as "and," "because" and "example" from the data set. Additionally, numbers and punctuation within words were removed, words and word pairs that occurred fewer than two times were excluded, word pair order was not preserved and English contracted forms were expanded. This procedure resulted in 190 unique words (nodes) and 262 connections (edges) between the words. We then used Gephi (Bastian *et al.*, 2009) to calculate the degree, and run the modularity algorithm (resolution: 1.0; modularity score: 0.174) for community detection (Brandes *et al.*, 2008). We scaled the nodes and edges based on degree and weight, i.e. the larger the degree, the larger the node; the greater the weight, the thicker the edge. To improve readability, we filtered out all nodes with a degree below 3, resulting in visibility for 20.53% of nodes and 80.35% of edges (Figure 4).

Findings. SemNA identified four distinct clusters, each encapsulating different facets of Cristiano Ronaldo's public persona. The largest cluster (blue, 15%) includes associations related to Ronaldo's former and current teams, as well as his main competitions. Core associations within this cluster are "realmadrid" (29), "portugal" (40) and "manchesterunited" (32). Lionel Messi ("messi" [24]) appears as another core association with links to associations such as "ballondor" (14) or "championsleague" (11). The green cluster (12%) centers on associations describing who Ronaldo is, featuring a blend of his professional accomplishments and personal life. The core association within this cluster is "worldfootballer" (32), representing a significant individual achievement for football players. Other associations focus on fame (e.g. "famous" [6], "rolemodel" [3], "star" [6]) and success (e.g. "winner" [4], "money" [9], "success" [8]), as well as associations regarding his family, including his wife ("georgina" [9]) and "children" (4). In the pink cluster (11%), key attributes and personality traits that distinguish Ronaldo are highlighted, including "hardwork" (8), "discipline" (8), "goals" (16), which surround the two most central associations "goat" (26) and "siuuu" (32). Interestingly, "siuuu," referring
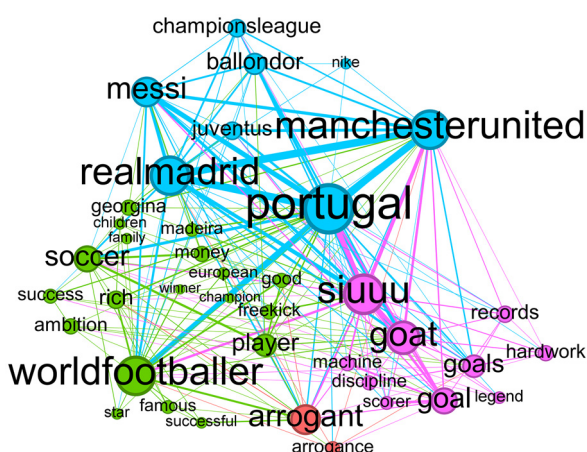

Figure 4.
Capturing the phygital social construct 'Cristiano Ronaldo'

Source: Author's own work

to his iconic cheer, is linked to both positive ("worldfootballer" [32]) and negative associations ("arrogant" [31]) – the latter making up the red cluster (5%).

These insights enable a deeper interpretation of Ronaldo's social construct, encompassing its phygital composition. To elaborate, prominent clusters primarily consist of co-occurring associations related to his former clubs ("realmadrid"), main competitions ("championsleague") and his enduring rivalry with Messi ("messi"). Especially the latter, forming a cross-cluster relationship to "goat," illustrates the phygital nature of Ronaldo's social construct. That is, the contentious debate on who is the greatest of all time particularly unfolds on social media and online forums. The other clusters further demonstrate the role of his carefully curated social media presence in the formation of core associations with his persona. Specifically, the widespread association with "siuuu" stems from both his iconic celebration on the pitch and the viral memes and reels circulating on platforms like Instagram and TikTok (Kassing, 2020). SemNA reveals that this association not only relates to positive but also to negative prejudice ("arrogance"). Other central aspects of the semantic network likewise highlight the phygital nature of Ronaldo's personal brand. For example, the centrality of family-related associations reflects Ronaldo's and his wife's ("georgina") frequent social media posts, which offer glimpses into their family life (Jorge *et al.*, 2022), solidifying his association with being a family man.

Discussion application area 3. This use case highlights the versatility of SemNA and its potential in examining phygital social constructs, seamlessly digitizing cognitive associations to form a holistic and tangible digital representation. Consequently, SemNA's output can be used for in-depth explorations and interpretations of facets of social constructs, including the intertwined physical and digital compositions inherent in today's phygital world. For example, the intuitive overview of associations' centrality through node size reveals the prominence of Ronaldo's iconic cheer "siuuu" within the investigated audience, shaped through both physical and digital channels (Kassing, 2020). Furthermore, insights into cross-cluster relationships, such as between "goat" and "messi," uncover underlying connections that may otherwise remain hidden but are crucial for forming a deeper understanding of phygital social constructs. Overall, this use case exemplifies a new application area for SemNA in consumer and marketing research, offering valuable insights by capturing comprehensive snapshots of complex social constructs.

Discussion

Consumer and marketing research increasingly demands sophisticated methodologies capable of analyzing large-scale text-based data (Humphreys and Wang, 2018). In particular, the confluence of physical and digital environments (Batat, 2023) poses methodological challenges for researchers addressing the hybrid nature of experiences and consumption phenomena at this intersection. Contributing to these timely discussions, we demonstrate that SemNA represents a well-suited method to address challenges in this evolving landscape as it supports researchers in exploring, understanding and accounting for the nature, size, scope and relationships between physical and digital elements of large-scale text-based data.

This paper illustrates the versatility of SemNA as a methodology that can be applied to various research phenomena and text-based data sources in phygital contexts (Batat, 2022, 2023) by presenting three application areas and use cases for SemNA in consumer and marketing research. The first application area uses SemNA to investigate the complex relationships between digital and physical consumption practices, as exemplified by analyzing narrative interviews about fashion content consumption on Instagram and its influence on physical consumption. The second application area uses SemNA to explore the

phygital nature of social media discourse, trends and practices through consumer-generated content. The third application area uses SemNA to convert phygital social constructs into tangible digital representations for subsequent in-depth exploration, as illustrated by the use case of Cristiano Ronaldo. This research contributes to recent fundamental work on computational text analysis methods in consumer and marketing research (Berger *et al.*, 2020, 2022; Humphreys and Wang, 2018) by focusing on SemNA as a computational method that centers on the visual exploration and interpretation of relationships and representations of knowledge, information, concepts and meanings in large-scale text-based data. Drawing on prior work from related disciplines that delineate general procedural steps for SemNA (Christensen and Kenett, 2021; Segev, 2021), our work offers guidance on *when*, *where* and *how* SemNA holds valuable potential for consumer and marketing research unfolding in contemporary phygital contexts. In doing so, we provide important steps toward facilitating the adoption, application and impact of SemNA in consumer and marketing research by outlining detailed accounts of application areas and demonstrating usage and interpretive analyses through specific use cases.

By highlighting this qualitative, interpretivist approach to SemNA, this research also contributes to pioneering discussions on integrating tool-based methods into qualitative, interpretivist methodologies (Caliandro and Gandini, 2017). Accordingly, this research opens methodological pathways for qualitative researchers that may encounter the limitations of both traditional and specialized qualitative research methods when analyzing large-scale text-based data in various research contexts. The outlined approach mitigates these limitations by using a *quant-qual* approach to SemNA, in which the quantitative part structures and visualizes the data, whereas the subsequent qualitative part then engages in data-driven, interpretivist exploration and theorization (Lucarelli *et al.*, 2023). As such, this approach provides qualitative, interpretivist researchers with the methodological means to properly grasp the nature, size and scope of unstructured, large-scale text-based data while maintaining an overarching interpretivist spirit.

Limitations and future research
Understanding the limitations of this research opens up opportunities for future research. First, this research exclusively focuses on the interactions between the physical world and social media. Future research should consider the broader spectrum of digital interactions outside social media platforms. Second, while this study proposes three broad application areas for SemNA, this selection may not fully capture the method's versatility and potential applications across different domains or contexts. We encourage future research to explore further application areas, supporting researchers in uncovering diverse insights and demonstrating the method's wider applicability and effectiveness in analyzing complex text-based data in phygital contexts. Third, the primary aim of the paper is to illustrate *when*, *where* and *how* SemNA can be used, therefore, prioritizing methodological exposition over comprehensive, context-rich interpretation. Researchers conducting empirically-driven studies to systematically investigate a particular phenomenon should engage in deeper interpretations. Fourth, this study uses only basic data cleaning procedures, such as removing stop words and does not use more nuanced preprocessing techniques, such as lemmatization or stemming (Balakrishnan and Lloyd-Yemoh, 2014), which may hinder the accurate representation and analysis of linguistic relationships in certain contexts. Finally, the qualitative, interpretivist approach to SemNA, while promising, is relatively new. More empirical research and methodological experimentation will be beneficial in identifying the optimal applications of this approach in various research contexts. This highlights the need for additional studies to refine the methodological framework, improve analytical

techniques and establish best practices for using SemNA in consumer and marketing research. General limitations of SemNA as a method must also be considered, including its inability to substitute for thorough reading and textual understanding, its challenge in fully capturing the context of word relationships without additional contextual intelligence by researchers and its incapacity to interpret linguistic ambiguities independently.

This paper aims to provide a foundation for the adoption and utilization of SemNA in consumer and marketing research. To facilitate this adoption, we illustrated possible research inquiries, including exemplary research questions and data sources, for each application area in Figure 1. Future research could use SemNA, for example, to investigate experiences and consumption phenomena in other phygital contexts, such as how the integration of augmented reality in retail environments influences consumer decision-making processes; to investigate how consumers narrate their physical consumption practices related to a specific discourse or lifestyle, such as sustainable fashion, on digital platforms; or to capture phygital social constructs across diverse segments with distinct digital behaviors. In general, we invite future research to join our endeavor by identifying and elaborating on further application areas and use cases for SemNA in consumer and marketing research, particularly in combination with artificial intelligence to potentially enhance SemNA's capabilities and automate aspects of the data analysis process.

Practical implications

The application areas outlined for SemNA demonstrate its utility for marketing and brand managers in gaining a comprehensive understanding of complex, multidimensional ecosystems composed of both physical and digital elements, including various relevant channels and stakeholders. SemNA empowers managers to capture and integrate company- and brand-related associations within their communication strategies, effectively addressing consumer-initiated trends and practices. Correspondingly, managers can use SemNA to acquire cross-channel and platform intelligence. Using SemNA fosters a consumer-centric, co-creative approach, positioning consumers as active participants in shaping the company's or brand's image.

Using SemNA to extract insights from text-based consumer data enables managers to "design appropriate and satisfying physical experiences while responding to consumers' functional, emotional, social, sensory, and symbolic needs across different consumption fields" (Batat, 2022: 8). For example, consumers often communicate their experiences via social media (Klostermann et al., 2018). Managers can leverage SemNA for real-time analysis and visualization of attitudes, associations or sentiments expressed on social media, allowing for prompt and informed decision-making. Additionally, managers can digitize data gathered in the physical world and translate them into the channel/platform language for their communication campaigns, e.g. hashtagging core associations on social media, thereby positioning the brand/company in the corresponding network. Similarly, SemNA enables managers to gain an increased understanding of brand perceptions (and other social constructs) and strategically manage brand reputation by analyzing corresponding associations and meaning clusters (Jaufenthaler et al., 2023).

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About the authors

Jonathan David Schöps is an Assistant Professor of Marketing at Stockholm Business School, Stockholm University. His research focuses on digital market dynamics and the role of digital technologies and nonhuman actors in market shaping. Methodologically, Jonathan specializes not only in digital methods, such as semantic network analysis or automated text analysis and visual methodologies but also holds expertise in traditional qualitative research methods. Jonathan David Schöps is the corresponding author and can be contacted at: jonathandavid.schoeps@gmail.com

Philipp Jaufenthaler is a postdoctoral marketing researcher at the University of Innsbruck, specializing in brand localness and the reputation of family firms. His research uses a versatile methodological approach, spanning from quantitative experimental studies to qualitative and mixed-method analyses. Beyond academia, he contributes his expertise as a strategy consultant, enhancing the practical applications of his research findings in the business world.