The Graying of the Digital Game Market in the Greater China Region: A Computational Framing Analysis of Media Discourses

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Abstract: The Greater China Region, commonly composed of China, Hong Kong, Macao, Singapore, and Taiwan, has seen the graying of their populations. With the global demographic shift that has been similarly observed in this region, senior gameplayers have increasingly represented an important market for digital game industries. Because of this global ageing/graying trend, the digital game industry has increasingly paid attention to the older digital gamers as a commercially profitable market segment. The sporadic data on senior gamers in the Greater China Region have supported the need to study this demographic segment to fill the literature gap to understand how media discourses represent this emerging demographic group. This text mining study examined their representations in the media discourses in this geographic region. Our analyses have found three extracted topics, "Game Genres," "Brain Training/Cognitive Benefits," and "Economic/Business Dimension," that best represent this increasingly influential demographic segment in the Greater China Region. Discussions and implications were provided.

Keywords: China, computational framing analysis, digital game, media representation, link analysis, senior gamers, text mining, the Greater China Region, topic modeling, word cloud

1. Introduction

The video gaming market size in the Asia Pacific Region will be around USD 53.34 billion by 2021 (Statista, 2021). The total number of gamers is estimated to reach 1.47 billion (Statista, 2021). In comparison, the total gaming revenue in Asia accounts for 47% of the world's total revenue (about USD 100 billion) (Business Wire, 2018). The Greater China Region commonly refers to China, Hong Kong, Macao, Singapore, and Taiwan (Klintworth, 1994), where common linguistic and cultural backgrounds and close trade/economic relationships are shared among these societies. This concept has sometimes been extended to include Singapore as part of the Greater China Region (William, 2016).

China is the world's largest digital game market, with its revenue reaching USD 37.9 billion, followed by the US (USD 32.7 billion) (*Newzoo*, 2018). The number of digital gamers in China has reached 640 million in the 2nd quarter of 2019 (Zhang, 2019), far ahead of previous estimates of 529.9 million in 2020, 551.2 million in 2021, and 570.5 million in 2022 (*eMarketer.com*, 2018a). Latest statistics have reported that China's digital gamer population has reached 740 million in late 2021, with its annual market of USD 45 billion a year (Holmes, 2021). Overall, the penetration rate of online digital games has consistently been over 50% from 2009 (at 68.9%), 2013 (at 54.7%), and 2017 (at 57.2%) (*eMarketer.com*, 2019). In the first half of 2021 alone, the total sale of digital games has reached USD 32 billion (Brooke, 2021). With the exponential growth of mobile devices in recent years, the PC client game market has declined from 75% in 2011 to 25% in 2019, while

mobile games grew from fewer than 10% in 2011 to 80% in 2022 (*eMarketer.com*, 2018b). Additionally, mobile gaming revenue (USD 2.36 billion) is estimated to dominate the gaming revenue segment in 2021, surpassing those of downloaded and online games combined (USD 1.61 million) (Statista, 2019). By 2023, most mobile gamers will be from China (Daniels, 2018).

Other parts of the Greater China Region also see the exponential growth of the digital game market and users. Taiwan is also the 15th largest mobile and PC game market and is projected to reach USD 2.8 billion in 2021 (ResearchAndMarkets.com, cited in Niko, 2018). On the other hand, Hong Kong ranks 30th in terms of the world's digital game revenue (about USD 390 million in 2018) (*Newzoo*, 2018). Its gamer population is expected to reach 34.5% in 2019 and will likely cover almost half of Hong Kong's population (around 49.2%) by 2023 (Statista, 2018b). There were 2.9 million digital game players in Singapore in 2017 (*Newzoo*, 2017). Digital game revenue was about USD 317.6 million in 2017 (*Newzoo*, 2017) and USD 319 million in 2018 (*Newzoo*, 2018). Among them, the mobile gaming market is expected to reach USD 97 million in 2019 and will reach USD 126 million by 2023, taking into account the growth rate of 6.9% between 2019 and 2023 (Statista, 2018a).

Despite these promising statistics, the digital game market in China has been facing some headwinds that could affect its future developments. For example, China has recently implemented a strict regulation to offer gamers younger than 18 years access only on Fridays, weekends, and public holidays (Brooke, 2021; Shanklin, 2021). Additionally, to log in to the gaming platform, real-name registration will be required to enforce the 3-hour playing time for minors to "curb videogame addiction and prioritize children's mental and physical health" (Shanklin, 2021, p. 14). Furthermore, in recent years, China's authoritarian control has been extended to the development of digital game content with the pretense of "they [Chinese gamers] don't really love grotesque monsters, goblins and ogres" and commercial enticement of "localization" for the Chinese gamers (Brooke, 2021, n.p.). The latest censorship practice has gone beyond the previous avoidance of politically and historically sensitive topics (such as Taiwan and Tibet issues). China's National Press and Publication Administration (NPAA) also employs a licensing approval scheme to grant licenses to only particular video game products that meet the party's agendas (Brooke, 2021). With these increasingly oppressive political and cultural trends in China and their potential side effects on Hong Kong and Macao, senior digital gamers present a less explored and studied market segment for the digital game industry.

1.1 The Graying Population in China

According to the Department of Economic and Social Affairs (DESA), Population Division, United Nations (2017), 13% of the world population (7.6 billion) is above 60 years old. In Asia, life expectancy used to be 65.2 years old (1990-1995), but it is expected to reach 72.9 years old (2015-2020) and 77.5 years old (2045-2050) (DESA, 2017). Three hundred thirty million Chinese residents will be over 65 years old by 2050 (Campbell, 2019). According to Taiwan's Directorate General of Budget, Accounting and Statistics (DGBAS), Taiwan's ageing index (computed by the number of seniors per every 100 young people under 15 years old) was 91.6, a rapid rise of 39.8 over the past ten years (Chen & Low, 2016). The aging population in Hong Kong was also reported in a collected volume by Woo (2013). The number of older residents (aged 65 years old and above) will account for 35.9% of the population (about 2.58 million) in Hong Kong by 2049 (Mok, 2018). The older population in Macao will increase by 7.5% annually to 74,100 in 2019 (*The Macau Daily Times*, 2019). Latest statistics reported that the elderly population (above 65 years old) had

surged 107.2% to 82,800 (Statistics and Census Bureau, 2021). In Singapore, 15.5% of its population (855,000 of the nation's estimated 5.71 million) are 65 years old (Siau, 2019). Through detailed statistics about senior gamers in the Greater China Region are not widely available, it is expected that a similar ageing trend in the Asia Pacific region can be observed in the Greater China Region (Parry et al., 2018). Therefore, it is expected that older adults/senior citizens will become a crucial digital game market in this region.

Because of this global ageing/graying trend, the digital game industry has increasingly paid attention to the older digital gamers (Brown & De Schutter, 2016; Hill, 2016; Knoop, 2017; Whitlock et al., 2011). The number of senior gamers (commonly defined as those above 50 years old) rises across economically developed countries. Digital game developers have increasingly targeted "royal and evergreen" (Woodside Capital Partners, 2015) gamers as a commercially profitable market segment. Popular digital games for older gamers include *Activator, Curball, DanceAlong, Silver Promenade, Virtual Soccer, and Waterball* (Sauvé et al., 2015). With the popularity of smartphones, many digital games can be available to older gamers as apps (such as *Lumosity, Peak, Elevate, Cognito*, and *Memorado*, among others) to help train their brain activities (AgingInPlace, 2020).

The sporadic data on senior gamers in the Greater China Region have supported the need to study this demographic segment to fill the gap in the literature. Existing studies (Lewis, 2013; Loos, 2017) have mainly focused on older adults' health and quality-of-life benefits of playing digital games. Survey methods were used to collect empirical data from senior gamers. However, media representations of "silver gamers" have not been widely studied (Lavenir & Bourgeois, 2019) in the extant literature to understand how this emerging gamer segment has been described in the mass media, particularly in China. Comparing the media representations of older gamers in this region will help document and examine how the mass media have represented this important gamer segment. The representations of female characters (Lynch et al., 2016) and same-sex relationships (The authors, 2018) have been popular in digital game research. However, the representations of gamers have not been extensively studied.

Furthermore, traditional media representations often rely on manual coding of media contents (Lynch et al., 2016). This study employed a computational framing analysis to examine many mass media discourses related to this emerging demographic segment. Specifically, the objectives of this study explore how mass media discourses represent senior gamers in the Greater China Region and, using this study as an example, demonstrate how the text mining method as a research technique can help digital game scholars study the media representation of topics in digital games.

2. Literature Review and Theoretical Framework

A substantial amount of empirical evidence has supported the positive effects of playing digital games on older adults psychologically (Loos & Zonneveld, 2016), physically (Lewis, 2013; Loos, 2017), and socially (Iversen, 2014; Schell et al., 2016; Zhang & Kaufman, 2016). Extant literature on older gamers often centers on older adults' gameplaying preferences (De Schutter, 2011; Souders et al., 2016), motivation to play digital games (De Schutter, 2011), digital gameplay patterns (Kaufman et al., 2016), game-based intervention to improve health benefits of older players (Boot et al., 2016), playing games and its positive impacts on active ageing (Ascolese et al., 2016; De Schutter et al., 2014; Valeria, 2016), gamification (Rubio et al., 2016), and actual gameplaying experiences (Kaufman et al., 2016). Extant literature often assumes that playing digital games will generate favorable socio-emotional and health-related benefits (Joinson, 2008).

However, a less explored question in the existing digital game literature is how senior gamers have been portrayed to justify the surging interest among academic and industry research in recent years. Older adults have traditionally been under-represented and negatively portrayed in mass and emerging media (Loos et al., 2017). While ample attention has been paid to younger gamers (such as Generation Millennials and Generation Z) (Zogby, 2014), Nap et al. (2009) once claimed that senior gamers are under-represented digital gamers and advocated the extensive study of this demographic group. Rarely studied is how mass media have described and portrayed senior gamers. An exception will be Lavenir and Bourgeois (2017), who collected a corpus of French, Belgian, and Swiss newspaper articles to identify discursive practices, normative paradigms, and extracted topics among these articles. Their study identifies eight topics, such as social economy, health benefits, game products, and characteristics, related to the description of older gamers in Europe.

2.1. Representing Senior Gamers in Mass Media

Digital game scholars have traditionally studied the representations of various digital game player groups. Most of these studies are a-theoretical and mainly focus on a detailed description of this emerging gamer segment. For example, Williams et al. (2009) studied the representations of gender, race, and age, and they speculated that a similar pattern of disparity of media representation in mass media is likely to be replicated in the emerging digital games. Their study confirms that ethnic male characters (85.23% of 133 games examined) dominate digital games, and characters of ethnic minorities are under-represented as expected (Williams et al., 2009). Monson (2012) also concurred that racial under-representation in *World of Warcraft* is seen in the mainstream mass media. While the representations of race, gender, and sexuality of digital gamers or characters have been extensively researched (Flanagan, 2015; MacKnight, 2013; Malkowski & Russworm, 2017), digital game scholars have recently begun to study how older gamers are represented in traditional and emerging new media platforms (Lavenir & Bourgeois, 2017; Loos et al., 2017; Loos & Ivans, 2018).

Loos et al. (2017) observed that older adults were often "under- and misrepresented" in the media by negatively portraying this market segment as "passive, alone, poor, in bad health" (p. 44). In general, older people are commonly described as "unskilled with new technologies" yet "eager to engage with modernity" (Caradec, 2001, cited in Lavenir & Bourgeois, 2017, p. 63). In the traditional mass media, Loos et al. (2017) note a widespread practice of underrepresenting or misrepresenting older people prejudicially in the media—a phenomenon later Loos and Ivans (2018) call "visual ageism." Playing digital games has been increasingly described in the media as a beneficial pastime for older adults to enhance their feelings in the ageing process (Lavenir & Bourgeois, 2017).

Connecting older adults with the meaningful (and beneficial) play of digital games has become one of the dominant representations in mass media narratives. Empirical digital game studies have often reflected the mass media's concerns, attempting to ascertain the relationship between positive health benefits and gaming activities of older adults (Ascolese et al., 2016; De Schutter et al., 2014; Valeria, 2016). For example, *CNBC News* interviewed a senior gamer and described her play as "I don't have too much social life. I'm mostly stuck at home, and I don't know" (Rosenblatt, 2019, n.p.). Similarly, Lavenir and Bourgeois (2017) identified eight topics (economic and strategic analysis, social connectedness, gameplay, and benefits to ageing, digital game products, and health benefits of gameplay, among others) after text analyzing 333 French-language newspaper articles in Europe.

2.2. Framing Research in the Age of Big Data

Framing theory describes the intentional and purposeful selection of facts and perspectives to construct "reality" by media organisations about a topic delivered through a communication medium and platform (Choi et al., 2019; Novak & Hakenan, 2013). The framing process usually implies the employment of various conceptions, perspectives, and viewpoints of a topic or an issue presented and communicated through a mass media organisation to the audiences (Diakopoulos et al., 2013). As a result, existing framing research has mainly focused on the choice and arrangement of frames by media organisations when different levels of salience are applied (Entman, 1993). Thus, studying these practices can often lead to discovering these media institutes and professionals (Field et al., 2018; Scheufele & Iyengar, 2014). A careful and thorough examination of their framing practices helps understand the filtering, selection, highlighting, and controlling of what information about an issue will be presented to their audiences to influence their perceptions (Greussing & Boomgaarden, 2017; Touri & Koteyko, 2015).

Framing research has often taken descriptive, experimental research, or both to describe the types of frames and their framing effects (Scheufele & Iyengar, 2014). In terms of the descriptive line of framing research, most of these studies have involved reading, interpreting, and categorizing many media discourses to identify "news frames" that media organisations have created in a cultural context (Touri & Koteyko, 2015). In other words, their research focus tends to center on how frames are built to set the public perceptions (Scheufele, 1999).

However, conventional framing and media representation research is constrained by its data processing ability to analyse a large amount of media data. Recent advances in computational data processing have enabled communication scholars to "identify salient formulations (frames) and to uncover how issues are represented differently by participants in discourses" (Touileb & Salaway, 2014, p. 635). As a result, framing researchers are among the first eager adopters of text mining techniques to uncover repetitive words, co-texts, phrases, topics, and themes in many (media) discourses. The practice of computational framing analysis has become popular in recent years (Field et al., 2018) and has been applied to digital game research to analyse media representations of digital game players (Lavenir & Bourgeois, 2017). The smooth transition from manual coding to automatic categorisation can be explained by traditional and computation framing analysis relying on similar units of analysis in identifying possible frames. Both approaches extract specific and repetitive words, phrases, and sentences from many media discourses (Touri & Koteyko, 2015).

Since then, framing research has progressed beyond simply identifying a list of frames and their variations that appear in the media discourses. Scholars have begun to examine the interactions among various actors, gatekeepers, agenda setters, and the audience inside or outside the media ecosystem (Refer to Greussing & Boomgaarden, 2017 for a review). Effects of ecological factors and media outlet qualities have been incorporated into recent framing studies (Greussing & Boomgaarden, 2017). For example, Greussing and Boomgaarden (2017) examined the media quality and temporal factors in explaining different news frames in reporting the refugee crisis in Europe based on media outlet quality and temporal factors.

Based on the discussions of relevant literature above, this study aims to answer the following research questions:

Research Question 1: What are the recurrent keywords, key phrases, and topics to represent senior gamers in the Greater China Region?

Research Question 2: How will text mining methods contribute to framing research in the media in this region?

3. Method

This study aims to employ a large-scale text mining method using Q.D.A. Miner and its affiliated WordStat 7 programs to analyse words, phrases, themes, and structures from a mass media corpus compiled to address senior gamers' emergence in China. The text mining technique has received acceptance and legitimacy in social science and humanity fields since 1960 (Bastin, & Bouchet-Valat, 2014). Touileb and Salaway (2014, p. 634) observed the potential of the text mining technique to conduct discourse-based analysis to "induce some constructions from large unannotated corpora" and "without prohibitively expensive manual coding" (Salaway, n.d., n.p.). The corpus-based media framing research has surpassed the traditional content analysis method because of the digitalisation of newspaper archives (Bastin & Bouchet-Valat, 2014). These developments have allowed researchers to identify semantic fields within the media discourses through frequency, concordance, and collocation analyses (Bastin, & Bouchet-Valat, 2014). The analyses of these mass media contents/discourses will also enable digital game scholars to identify primary linguistic forms, frames, and phrases related to senior gamers in the Greater China Region. In this study, we used the term "discourse" interchangeably with "contents" and "corpus" to refer to the linguistic forms and expressions of ideas and opinions of a person or a media outlet (Baker, 2006; Touileb & Salway, 2014).

3.1 Text Mining as an Emerging Research Technique

Text mining has been increasingly gaining attention among social science scholars (Bastin, & Bouchet-Valat, 2014; Diakopoulos et al., 2013; Kand & Yang, 2022). The techniques have been used to study blogs/forums, emails, online libraries, social networks, and websites (Altınel & Ganiz, 2018). Several applications have emerged to allow researchers to identify repetitive keywords, phrases, and topics in the media corpus through document classification, filtering, summarisation, and sentiment analysis (Altınel & Ganiz, 2018). Text mining has recently emerged as a feasible method for communication scholars to study news frames while reducing human interference (Kang & Yang, 2022). Several text mining procedures and techniques have been employed in previous corpus-based news framing analyses (Field et al., 2018; Greussing & Boomgaarden, 2017; Touri & Koteyko, 2015). For example, Touri and Koteyko (2015) used both keywords and concordance techniques from "corpus linguistic techniques" to identify news frames "that exhibit deeper cultural values and are more likely to shape the receivers' interpretations" (p. 601). All text mining techniques will enable researchers to identify "the characterisation of how issues are framed" (Touileb & Salaway, 2014, p. 635).

Corpus-based linguistic techniques have been commonly used in social science research that deals with many discourses from news and social media outlets (Touileb & Salaway, 2014). We have similarly employed a corpus-based automated frame analysis to examine representations of keywords or frames in the media corpus after extracting these repetitions across different texts (Greussing & Boomgaarden, 2017). This methodological innovation addresses the problem with the conventional Bag of Words (BOW) approach that analyses "information about the terms and their corresponding frequencies in a document independent of their locations in the sentence or document" (Bastin, & Bouchet-Valat, 2014, p. 1130).

In addition to locating keywords from the media discourses, corpus-based discourse analysis also aims to locate the contextual meaning of these keywords by examining concordance lines or collocations in the texts (Baker et al. 2008, cited in Greussing & Boomgaarden, 2017). However, Greussing and Boomgaarden (2017) described the corpus-based discourse analysis as identifying "statistically significant lexis and lexical patterns in a corpus evolving around specific target terms" (p. 1755). On the other hand, the automated frame analysis can identify and analyze "conventionalized keyword combinations" as dominant frames that appear in the media discourses (Greussing & Boomgaarden, 2017, p. 1755).

This study mainly relied on the automated frame analysis to generate discussions for empirical results. The keyword function is most relevant to this study and helps highlight the most salient ideas and opinions as reflected in the media discourses as possible new frames (Touileb, & Salway, 2014, p. 635). *Q.D.A. Miner* allows identifying keywords with the highest frequencies from the media corpus and reflects the most essential and salient frames related to the news discourses (Touri & Koteyko, 2015). According to Touri and Koteyko (2015), the identification of keywords will help the researchers to find "important concepts in a text which may help 'diagnose' and 'nominate' central ideas around which the frame is constructed" (p. 605). Touri and Koteyko (2015) below explain why keywords can be used as potential news frames in the media corpus:

> *By identifying words whose frequency is unusually high in comparison with some norm, the 'keyword' function can elicit words that can work as indicators of emphasis and that concentrate meanings that are drawn from cultural values, political discourses as well as journalistic norms.* (p. 606)

On the other hand, the concordances (or collocations) function helps detect co-texts around keywords to provide insights into meanings related to the studied issues (Touileb & Salway, 2014). This function allows researchers to read thoroughly texts surrounding the keywords to interpret these salient concepts and terms in context. Concordance is defined as "an alphabetical list of the words (types) in a text corpus and references to those parts of the text where the individual occurrences (tokens) of the word may be found ……[as] illustrated by a quotation drawn from the text" (Howard-Hill, 1979, p. 3). Touri and Koteyko (2015) described the usefulness of the concordance function: "Examining how such keywords are used through concordances and whole texts and what framing and reasoning devices they may have in common should therefore be revealing" (p. 606). The Keyword-in-Context (KWIC) is a popular concordance feature in computer processing of natural language texts (Wood, 1984).

3.2 Sampling Method and Sample Description

This study used *Q.D.A. Miner* and its added program, *WordStat 7*, to analyse media corpus collected from the mainstream English-language media, using three keyword/phrase pairs, "Older Players" and "Video Game," "Older Adults" and "Video Game," "Seniors," and "Video Games," to search the *Lexis/Nexis Academic* database. The searches have generated a total of 292 articles for "Older Players" and "Video Game" pair, a list of 226 articles for "Older Adults" and "Video Game" pair, and a total of 990 articles for "Seniors" and "Video Games" pair. After using the high similarity filter function embedded in the *Lexis/Nexis Academic* database, we purposely selected articles based on geographical areas by focusing on the Greater China Region. Major newspapers that contribute to the compilation of our media corpus include *The New York Times*, *South China Morning Post*, *The Strait Times*, and *The Guardian*, among others. We used keyword extraction, topic modeling, link analysis, and map techniques to provide empirical data for the above research

questions. Refer to Table 1 below for the keyword search strategies, database searches, and article hits.

Table 1. Corpus for Text Mining Analysis Based on Lexis/Nexis Academic Search

Keywords	Keywords (Geographical Regions)	N	Valid N (after removing duplicates. High Similarity Filter)
"Older Players" and "Video Game" (search date: December 23, 2018) (Total 292 articles retrieved.)	China	7	7
	Hong Kong	1	1
	Macao	0	0
	Taiwan	0	0
	Singapore	4	4
"Older Adults" and "Video Game" (search date: December 23, 2018) (Total 226 articles retrieved.)	China	13	13
	Hong Kong	3	3
	Macao	0	0
	Taiwan	4	4
	Singapore	7	6
"Seniors" and "Video Game" (search date: December 23, 2018) (Total 990 articles retrieved.)	China	37	36
	Hong Kong	17	16
	Macao	0	0
	Taiwan	8	8
	Singapore	29	29

4. Findings and Discussion

4.1 Findings from Keyword Analysis

Using *QDA Miner* and its affiliated program, *WordStat 7*, we have generated over 100 keywords from the media discourse corpus. These keywords represent how older gamers in this region have been represented in the mass media corpus. For example, keywords such as "time" (57.1% of the cases in the corpus, TF-IDF=14.8), "social" (60.7%, TF-IDF=12.1), "market" (53.6%, TF-IDF=14.6), "brain" (3.6%, TF-IDF=50.7), "training" (10.7%, TF=IDF=21.3), "fun" (25%, TF-IDF=8.4), "mental" (14.3%, TF-IDF=11.8), "cognitive" (7.1%, TF-IDF=11.5), and "memory" (7.1%, TF-IDF=11.5) (Refer to Table 2). According to Rajaraman and Ullman (2011), TF-IDF (term frequency-inverse document frequency) is a metric to measure the extracted word's importance in documents.

Table 2. List of Selected Keywords Extracted from the Corpus

Extracted Keywords	Frequency	Number of Cases	% of Cases	TF-IDF
Time	61	16	57.1%	14.8
Online	60	16	57.1%	14.6
Social	56	17	60.7%	12.1
Market	54	15	53.6%	14.6

Industry	42	11	39.3%	17.0
Billion	35	12	42.9%	12.9
Brain	35	1	3.6%	50.7
Entertainment	32	13	46.4%	10.7
Mobile	32	11	39.3%	13.0
Business	29	17	60.7%	6.3
Million	29	15	53.6%	7.9
Revenue	26	11	39.3%	10.5
Sports	25	5	17.9%	18.7
Training	22	3	10.7%	21.3
Experience	15	9	32.1%	7.4
Multiplayer	15	4	14.3%	12.7
Arcade	14	2	7.1%	16.0
Fun	14	7	25.0%	8.4
Mental	14	4	14.3%	11.8
Nintendo	14	7	25.0%	8.4
Kinect	13	4	14.3%	11.0
Addiction	12	4	14.3%	10.1
Active	11	5	17.9%	8.2
Friends	11	8	28.6%	6.0
Casual	10	3	10.7%	9.7
Cognitive	10	2	7.1%	11.5
Memory	10	2	7.1%	11.5
Practice	10	6	21.4%	6.7

Based on the extracted keywords, it is evident that the media corpus in the Greater China Region has represented the emphasis on the commercial interest frame when talking about older gamers in the Greater China Region by describing the older gamer segment by words such as "market," "industry," "billion," "business," "million," "revenue"—all of which have the TF-IDF values from 6.3 to 17.0. It is also noteworthy that most of the keywords (except the word "addiction") in the analysis do not suggest any concern for potential physical dangers and destructive social issues that may affect older gamers, confirming the strong tendency toward framing this emerging demographic segment as a business topic. The multi-faceted media representations of senior gamers in Europe (such as Levenir & Bourgeois, 2017; Loos & Ivans, 2018; Loos et al., 2017) and US media (Rosenblatt, 2019) demonstrate an exciting difference, in contrast to the strong emphasis on the economic benefits of this emerging market segment in the Greater China Region. This phenomenon has been visually represented in the Word Cloud figure (Refer to Figure 1), which may also demonstrate the national fascination with economic development in this region over the past decades when salient keywords such as "market" and "industry" are highlighted.

Figure 1. Word Cloud of Most Salient Keywords

Another list of salient words can be extracted from Table 2 to represent the social, experiential, physical, and cognitive benefits of playing digital games for senior adults in the Greater China Region. This finding aligns with much academic research arguing the quality-of-life benefits playing digital games may have for older adults (Lewis, 2013; Loos, 2017). The analyses in both Table 2 and Figure 1 demonstrates the most salient frames based on the frequencies and TF-IDF metrics of each keyword in the media corpus include "social" (TF-IDF=12.1), "brain" (TF-IDF=50.7), "entertainment" (TF-IDF=10.7), "training" (TF-IDF=21.3), "fun" (TF-IDF=8.4), "experience" (TF-IDF=7.4), "mental" (TF-IDF=11.8), "cognitive" (TF-IDF=11.5), and "memory" (TF-IDF=11.5) (Refer to Figure 1 and Table 2).

Using the Keyword-in-Context function that the text mining tools have provided helps us thoroughly examine how older gamers have been described in the media corpus. Unlike traditional quantitative content analysis, the KWIC function will provide further insights into the media corpus data when extracted keywords are placed in the actual texts. For example, regarding the extracted keyword, "social" as one of the quality-of-life benefits of playing digital games, one of the senior gamers, Ms. Tan, describes her motivation to play her favourable game:

> *Ms Tan links her game loyalty to the social element - 'the ability to yak and strategise with members of my mafia clan.' For others, satisfaction comes from the freedom to act out roles that are taboo in the real world.* (Article#18 from the media corpus).

Another article has described that playing digital games sometimes creates nostalgic values for older gamers:

> *Often, nostalgia "is not about the specific game but about the social experiences involving that game," he said. "The games we played in our youth would likely elicit the greatest amount of nostalgia". This has not been lost on videogame makers, who have started offering revamped versions of vintage games in their online stores, such as Nintendo's Super Mario 3: Mario Forever.* (Article #7)

One of the most advocated benefits of playing digital games for senior gamers is the enhancement of cognitive and brain capacities (AgingInPlace, 2020). Another keyword, "brain," has allowed us to understand the description of older gamers seeking brain training to maintain their cognitive capabilities (Article #9):

> *She became quite addicted to NeuroRacer -- and good at it. "I was really kind of sad when they took it away from me!" she said. Her experience illustrates both the potential and the limits of brain training. Technically, she's part of the cohort who improved and says she feels she became better at multitasking, "more conscious of what I was doing every day." But she struggled when*

I asked her for examples of how this had improved her daily life. In fact, to keep from forgetting her purse, she hit upon a more prosaic, low-tech solution: She bought a bigger one that's harder to leave behind accidentally.
The elderly have long been masters of devising clever tricks to compensate for mental failings, turning objects all around them into cognitive props. Medicine might be left on the kitchen table, its presence there a daily reminder that pills need to be taken. To-do lists on Post-it notes serve as scaffolds for their memory. If you've already lost cognitive function, and brain training can only go so far, you find other ways to cope.

4.2 Results from Key Phrases Analysis

The critical phrase extraction technique helps summarise key topics and phrases from the documents (Papagiannopoulou & Tsoumakas, 2018). Analysing most recurring phrases helps extract idioms and common phrases in the corpus (Provalis Research, 1989-2014). According to the user manual (Provalis Research, 1989-2014), the phrase extraction function could address what keyword extraction cannot accomplish once idioms and phrases are carefully examined to represent what a document means accurately. This study relied on TF-IDV statistics as a baseline to examine the frequency of each key phrase, "multiplied by the inverse of their frequency in all documents of a collection" (IDF) (Papagiannopoulou & Tsoumakas, 2018, p.889).

Additionally, in the *WordStat 7* program, the phrase extraction function allows a researcher to perform co-occurrence and comparison analysis (Provalis Research, 1989-2004). As demonstrated in Table 3 below, some of the recurring phrases from the media discourses include "Honors of Kings" (17.9% of the cases in the corpus, TF-IDF=15.7), "Brain Training" (3.6%, TF-IDF=15.9), "Business Model" (14.3%, TF-IDF=5.1), "Social Media" (14.3%, TF-IDF=5.1%), "Working Memory" (3.6%, TF-IDF=8.7), suggesting the emphasis on the economic as well as quality-of-life benefit dimensions to represent the older gamers in the Greater China Region. In other words, the digital game industry is most concerned about the gaming platforms and game genres, according to the media discourses (Refer to Table 3 and Figure 2 below).

The great emphasis on the utilitarian aspect of the digital game industry and various digital game platforms and genres can be attributed to its immense economic benefits and monetary values related to content developers, designers, and gaming influencers (Milton, 2017). Many export and manufacture-based economies in this region intend to capitalize on the rapid growth of global gaming revenue, estimated at USD 200 billion by 2023 (Newzoo cited in Panhans, 2021, n.p.). For example, the growing popularity of eSports originated in South Korea and is estimated to grow to USD3.5 billion in 2025 (Campe, 2021). Mobile eSports revenue in 2019 reached USD13.3 billion in 2019, accounting for 68% of its world revenue (Juniper, cited in Campe, 2021, n.p.). Almost 50% of the 1 billion global eSports viewers are from Asia (Campe, 2021). Among many countries in Asia that eagerly embrace eSports business opportunities, China has teamed up with Tencent to adjust its higher education curriculum and degree offers since 2017 (Campe, 2021). Similarly, the Hong Kong Government has also taken a similar approach to foster eSports development through event sponsorship, talent training and recruitment, infrastructure development, and curriculum innovation in its educational system (Hong Kong Cyberport Management Company Limited, 2017).

Media discourses that focus on how playing digital games can benefit the elderly population cognitively in this region echo commercial and business opportunities associated with the increasingly graying of demographics among societies in the Greater China Region. Topics

extracted from our media discourses represent the framing of digital games with "brain training", "business model", and "working memory", suggesting the product benefit positioning of many digital game marketers when they associate the use of digital games with the enhancement of mental capacities for the elderly population.

Table 3. Results of Extracted Phrase Analysis

Extracted Phrases	Frequency	Number of Cases	% of Cases	TF-IDF
Honour of Kings	21	5	17.9%	15.7
Loot Boxes	13	1	3.6%	18.8
Brain Training	11	1	3.6%	15.9
Counter Strike	11	1	3.6%	15.9
Mafia Wars	10	2	7.1%	11.5
Massively Multiplayer	10	2	7.1%	11.5
League of Legends	9	4	14.3%	7.6
Soft Toy	8	1	3.6%	11.6
Angry Birds	7	1	3.6%	10.1
Business Model	6	4	14.3%	5.1
Goods Market	6	2	7.1%	6.9
Social Media	6	4	14.3%	5.1
Working Memory	6	1	3.6%	8.7
Interactive Entertainment	5	2	10.7%	4.9
Posit Science	5	1	3.6%	7.2
Research Firm	5	5	17.9%	3.7
Triad Member	5	1	3.6%	7.2
Vice President	5	5	17.9%	3.7
Xbox Live	5	1	3.6%	7.2

Figure 2. Word Cloud of Most Salient Key Phrases

4.3 Findings from Topic Extraction

WordStat 7 allows researchers to reveal the corpus's hidden thematic/topical structure using natural language processing and factor analysis with Varimax rotation (Provalis Research, 1989-2014). The Topic Extraction function embedded in *WordStat 7* processes the documents in the media discourse corpus by developing a word frequency matrix and then undergoing Varimax rotation

to discover a list of topics (Provalis Research, 1989-2014). We employed the same Latent Dirichlet Allocation (LDA) technique (Lavenir & Bourgeois, 2017) to identify a set of words that semantically converge to form a salient topic extracted from the media corpus. As a popular approach to examining words' representation in the document corpus since 1990, LDA is also based on a co-occurrence matrix to capture the semantic structure and reduce dimension in the media discourses (Papagiannopoulou & Tsoumakas, 2018). Salient frames can be identified by the topic modeling technique (Nguyen et al., 2013).

Unlike the conventional content analysis method that allows human coders to name categories after carefully assessing their theoretical relevance to their study, automatic topic modeling techniques sometimes are criticised for generating "poor quality topics" (Mimno et al., 2011, p. 262). The following Table 4 showed the results of the topic modeling process when three topics were extracted from the media corpus on older gamers in the Greater China Region. These extracted topics include "game genres" that older adults play (Coherence=.33, 92.9% of the total cases), "brain training/cognitive benefits" (Coherence=.42, 60.7% of the total cases) that motivate older adults to play, and "economic/business dimensions" (Coherence=.34, 96.4% of the total cases) of the older gamer segment. Topic 1 is generated from the keywords in the media corpus, such as "multiplayer," "online," "Warcraft," "triad," "mobile," "smartphone," etc. Topic 2 is based on the keywords such as "brain," "cognitive," "training," "memory," "mental," "research," and "brain training," while Topic 3 is made of keywords such as "billion," market," global," "hardcore gamers," etc.

Table 4. Results of Topic Modelling Analysis

Extracted Topic	Keywords	Coherence	Frequency	% of Cases
Game Genres	multiplayer; massively; online; strike; counter; Warcraft; Xbox; live; entertainment; massively multiplayer; honour; kings; Tencent; triad; students; join; addiction; smartphone; mobile;	.33	197	92.9%
Brain Training/Cognitive Benefits	brain; cognitive; training; memory; mental; elderly; work; aging; speed; research; brain training	.42	90	60.7%
Economic/Business Dimension	goods; report; billion; social; market; Pokemon; states; research; global; network; hit; goods market; hardcore gamers	.34	134	96.4%

4.4 Findings from Link Analysis

To understand better the relationships among extracted keywords, phrases, and topics from the media discourses that we have collected to represent older gamers in the Greater China Region, *Link Analysis* in *WordStat 7* is a valuable procedure to identify co-occurrences to explore associations between these categories (Provalis Research, 1989-2014). As presented in Figure 3 below, the network graph will allow the researchers to explore relationships among the extracted concepts (nodes) and understand associations' strengths. We intentionally selected the nodes (concepts) most relevant to older adult gamers in the Greater China Region by placing "elderly" as the destination node. As seen in the Link Analysis figure, the economic/business and quality-of-life benefit frames from the media corpus have been confirmed; the node, "Elderly," is closely linked with "Firm" (.146), "Spend" (.136), and "Longer" (.105), suggesting that the framing of older gamers in the Greater China Region often centers on its business potential for the digital game industry. Another part of the nodes includes keywords such as "Memory" (.178), "Cognitive" (.138), "Training" (.250), "Speed" (.105), and "Brain" (.11), representing the motivations behind these senior gamers to allow them to live an active life, echoing the ageing demographic trend as described above. As demonstrated in the visualisation below, it is evident that, when it comes to the representations of older gamers, the mass media tend to associate them with the "gameplay leading to active ageing" frame (similar to Lavenir and Bourgeois's, 2017, topic 3) (Refer to Figure 3).

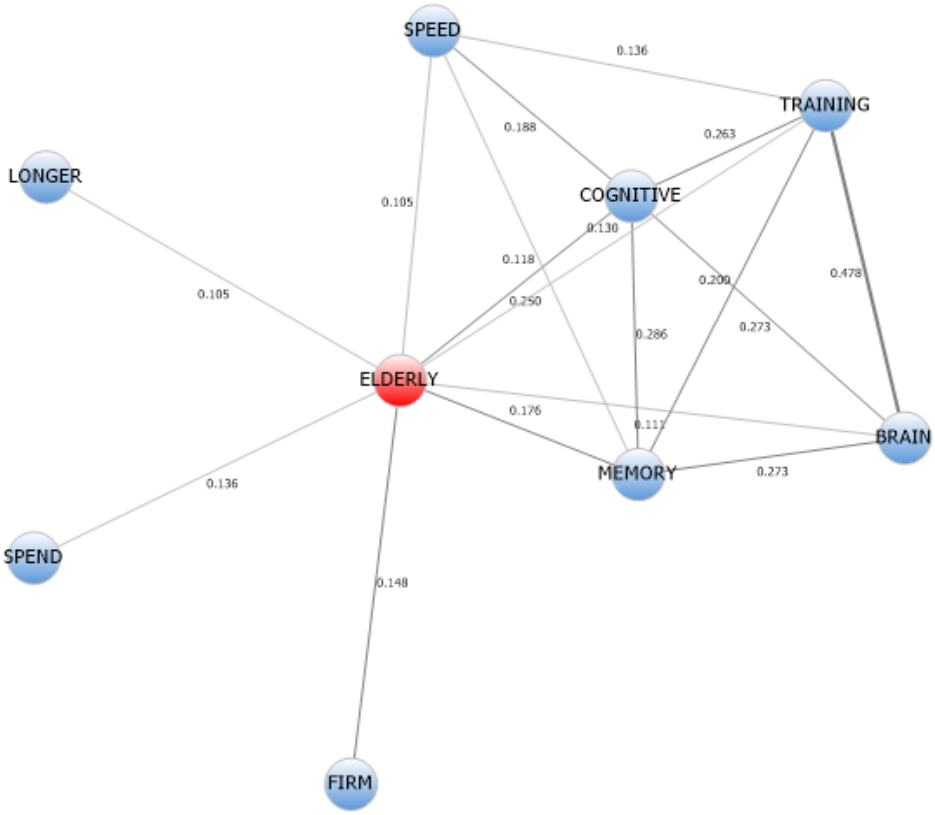

Figure 3. Link Analysis Results

5. Conclusion

Complex issues such as how the digital game industry would respond to the coming of silver gamers in the Greater China Region can be best studied by examining media discourses that offer frames (or perspectives) to discuss relevant issues. This study has offered an overview of the potential impacts of older gamers in the Greater China Region by first examining current industry statistics. Then, we have explained the ageing trend around the world that is likely to affect the digital game industry by focusing on how the mass media corpus has represented this emerging market segment in the Greater China Region. We have also argued that framing theory and computational framing analysis could offer a methodologically innovative approach to provide empirical data to help digital game researchers theorise what the digital game industry thinks about many issues posed by the graying of the populations in this region. This study employed a text mining technique to help analyse media discourses and has identified recurrent keywords, phrases, topics, and relationships from the corpus. This study offers an initial attempt to apply the text mining method to study digital games. Existing research on the representations of senior gamers is unfortunately descriptive and exploratory (Lavenir & Bourgeois, 2017; Loos et al., 2017; Loos & Ivans, 2018). This study similarly is a-theoretical but aims to demonstrate how text mining techniques can help digital game researchers study the representation issues.

5.1 Limitations and Future Research Directions

The following limitations also constrain the present study. First, the number of articles in the corpus does not allow a longitudinal analysis of the data to see how frames evolve (Greussing & Boomgaarden, 2017) and across five different societies in the Greater China Region. A purposeful sampling of articles was selected to meet the geographical criteria. It is likely that the emergence of older gamers is a recent phenomenon and has just begun to attract the attention of the digital game industry and has limited the number of articles to be analysed. As a result, the analysis of frame variations over time to find different framing patterns longitudinally is not feasible for the present study.

This study focuses on the computational framing analysis of salient words, phrases, and topics in media discourses. However, various factors may affect how different frames were extracted to show how older players were represented in the media discourses in this region. For example, Greussing and Boomgaarden (2017) argued that the audience's interests might also affect how media organisations may report a crisis (such as refugees in Europe). Similarly, whether the general public and the digital game industry are eager to embrace the opportunities of older adults will influence the representations of related issues in the media. This study has mainly focused on the media frames (Scheufele, 1999), not how the audience has perceived these framing practices. As an exploratory study, this study does not investigate how different media frames may influence the audience's perception of older gamers in the Greater China Region.

Thirdly, the processing of words, keywords, phrases, lexicons, and dictionaries in identifying recurrent linguistic patterns to generate findings may ignore the diversity of word meanings (i.e., polysemy) (Tesoa et al., 2018). The use of keywords and phrases similarly runs into problems of reducing their importance in different contexts and should be addressed by statistical procedures (Tesoa et al., 2018).

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