

HOSTED BY



Contents lists available at ScienceDirect

International Journal of Nursing Sciences

journal homepage: <http://www.elsevier.com/journals/international-journal-of-nursing-sciences/2352-0132>



Special Issue: Medicine, Humanity and Media

Analysis of the interactive meaning of journalistic images of the human papillomavirus vaccine and the perceptions of female undergraduate students

Jingxi Chen^{a,*}, Ran Tao^b, Qiaomin Guo^c

^a School of Languages and Communication studies, Beijing Jiaotong University, Beijing, China

^b School of Journalism and Communication, Peking University, Beijing, China

^c School of New Media, Peking University, Beijing, China

ARTICLE INFO

Article history:

Received 29 March 2020

Accepted 6 July 2020

Available online 9 July 2020

Keywords:

Attention

Eye tracking

Journalistic image;

Medical decision making

Papillomavirus vaccines

Visual grammar

ABSTRACT

Objectives: This paper focuses on the underlying mechanisms of women's perceptions of persuasive visual health information.

Methods: In the image viewing process, a separation between the image producer and the image viewer occurs, and the connection between the two is fractured. This mixed method research included modal discourse analysis (coding based on visual grammar theory), an eye tracking experiment, a questionnaire survey, and in-depth semi-structured interviews. The interactive meanings of journalistic images related to the human papillomavirus (HPV) vaccine were identified through four sets of codes. In addition, the perceptions of female viewers were analyzed.

Results: In the first set of stimuli, i.e., the infographic, the female participants focused most of their attention on information about the nine-valent HPV vaccine. An analysis of the interactive meaning of two sets of journalistic pictures, i.e., fictional pictures and nonfictional pictures, indicated that the image producers did not implement useful viewer involvement strategies to persuade viewers. Furthermore, female viewers focused their attention on the "similar other" during the viewing process, gazing at the patient the longest as the primary area of interest (AOI).

Conclusions: The study indicates that the current persuasive visual information about the HPV vaccine needs further improvement due to the high demand for information about HPV from the Chinese female audience.

© 2020 The author(s). Published by Elsevier B.V. on behalf of the Chinese Nursing Association. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

What is known?

- Cervical cancer poses a considerable threat to women's health internationally. The human papillomavirus (HPV) vaccine thus plays an increasingly important role in effective prevention, as it can significantly reduce the likelihood of developing the disease.
- In the image viewing process, a separation between the image producer and the image viewer occurs, and the connection between the two is fractured. This disconnection can cause challenges and introduce questions regarding the distribution of health information.

What is new?

- The HPV journalistic image producers did not implement useful viewer involvement strategies to persuade viewers.
- The female viewers focused their attention on the "similar other" during the viewing process, gazing at the patient the longest. Therefore, the visual persuasion should adopt a patient centered communicative strategy.

1. Introduction

In the digital era, the question of what types of mechanisms influence audience perceptions of medical-related journalistic images remains unanswered. In the viewing process, a separation between the image producer and image viewer occurs, and the connection between the two is fractured. This disconnection can

* Corresponding author.

E-mail addresses: jqchen@bjtu.edu.cn, jingxi.chen@outlook.com (J. Chen).

Peer review under responsibility of Chinese Nursing Association and MHM Committee.

cause challenges and introduce questions regarding the distribution of health information.

This paper discusses women's perceptions of health information, focusing on cervical cancer data, as cervical cancer is the second most contracted cancer by women worldwide. Cervical cancer is difficult to cure. It poses a considerable threat to women's health internationally. The human papillomavirus (HPV) vaccine thus plays an increasingly important role in effective prevention, as it can significantly reduce the likelihood of developing the disease. For these reasons, cervical cancer prevention was chosen as the focus of this research.

To bridge the gap between the producers of preventive health images and the viewers of these images, this paper analyzes the new social relationships that are constructed as a result of journalism practices and female viewers' cognitive perception. Visual grammar theory asserts that through the process of image viewing, the viewer and the image producer create a new, meaningful social relationship, which makes the image viewing process part of a social interaction. This study examines how visual information in the media interacts with female undergraduate students' recognition processes and analyzes the new social relationships that are constructed during the viewing process.

2. Methods

2.1. Participants

Given the large scale of eye movement data, the number of experiment participants in previous studies has mainly been 15 to 45. Through an official We Chat group for the School of Languages and Communication Studies of Beijing Jiaotong University, 20 qualified subjects were recruited among female college students enrolled in the school [1]. The average age of the participants was 20 years. There were no barriers to the participants' information recognition, and all participants had normal or corrected-to-normal vision. The participants were all liberal arts majors. Previous studies have shown differences in students' cognition of the HPV vaccine by student major mainly between medical and nonmedical majors [1,2]. In addition, a study by Huang et al. showed no significant difference in cognition of and attitude towards the HPV vaccination among liberal arts and science majors [3]. The present study was conducted over three days, with 4 participants on the first day, 7 participants on the second day and 9 participants on the third day.

2.2. Study design

This study involved an eye-tracking experiment. The researchers chose 13 journalistic images from the largest Chinese online open image database, Visual China (www.vcg.com), as the materials for the eye-tracking experiment with female college students.

Thirteen journalistic images were selected through intentional sampling and then classified into three sets. The 13 images included one infographic and two sets of a total of 12 journalistic pictures. The researchers divided the journalistic images into two sub-categories: nonfictional and fictional. Coding was conducted using interactive meaning analysis according to visual grammar theory introduced by Kress and Leeuwen (2006) [4]. The eye-tracking indicators included the pupil diameter, total fixation duration, and time to first fixation in each experimental session. The eye movement sequences of the participants were described based on the areas of interest (AOIs).

By conducting in-depth semi-structured interviews and surveys with all participants immediately following their eye-tracking

sessions, the authors identified several characteristics of Chinese female undergraduates' perception of journalistic images related to the HPV vaccine.

2.3. Variables

The determination of the visual AOIs was conducted by two research assistants, whose independent analyses were then discussed with a third research assistant. The total fixation duration and the time to first fixation on the AOI were counted, and the fixation duration, time to first fixation and viewing sequence of each AOI were analyzed. The eye movement parameters and their definitions in this article are described below.

Pupil Diameter: The diameter of each participant's pupils while viewing the pictures reflects the participant's emotional response to information in the picture.

Total Fixation Duration: The total time participants spent viewing each AOI reflects the degree of attention to the informational elements in each section of the image.

Time to First Fixation: The time required for each participant to look at each AOI indicates the order of the participant's attention to each section of the picture. According to these parameters, the participants' eye movement sequences could be identified and explained.

2.4. Ethical considerations

Participants were informed about the data security procedures to ensure the confidentiality of participant information. The researchers enhanced the viability and reliability of the study by obtaining informed consent and ensuring confidentiality. Each participant was informed that the interview would be recorded and was given the opportunity to review the transcribed interview. All participation in this study was strictly voluntary, which was communicated in the informed consent letter.

2.5. Data analysis

This study employed the methods of multimodal discourse analysis (i.e., visual grammar theory), eye tracking, semi-structured interviews, and surveys.

All data were recorded with the Tobii Pro Spectrum Eye Tracker. This device can perform data capture at 1200 Hz and is equipped with a 23.8-inch display with a resolution of 1920 × 1080 pixels. To minimize the impact of uneven light, the light source in the laboratory was kept constant. During the experiment, the experimental stimuli (images) were displayed on the screen, and the eye tracker recorded the participants' eye movements. This study was designed to show each participant 13 stimulus images. The eye movement tracking experiment lasted approximately 10–15 min for each participant. After the eye movement tracking experiment, in-depth interviews and questionnaires were conducted for further investigation.

3. Results

3.1. Viewing analysis of the infographic

The infographic is about HPV vaccine introduction in Chinese (Fig. 1) and its contents in English are shown in Table 1. After the regions of interest were coded by AOI, the total fixation duration of all participants was analyzed (Fig. 1). It was determined that the five most-viewed areas on the images presented to the participants were the prevention function, applicable age, vaccine issue time, and price of the nine-valent HPV vaccine. Overall, the participants

gave 39.42% of their attention to information concerning the nine-valent HPV vaccine, 33.55% to the tetravalent HPV vaccine, and 19.11% of their attention to the bivalent HPV vaccine.

To analyze variations in visual fixation on the same picture among the participants, the researchers designed analysis units for the visual stimulus material. By defining the boundary of the visual AOs in the stimuli, the researchers divided different targeted regions into different elements. According to the experimental data, the AOs that the participants spent the most time to the least time focused on were as follows: 1) nine-valent vaccine prevention, 2) recommended age for the 9-valent vaccine, 3) bivalent vaccine prevention, 4) nine-valent vaccine issue time, 5) nine-valent vaccine price, 6) quadrivalent vaccination injection procedures, 7) bivalent vaccine issue time, 8) quadrivalent vaccine and prevention of disease, 9) prevention, 10) bivalent vaccine price, and 11) price.

3.2. Attention analysis of the new social relationships formed through image production

When people “read” visual images, they do not distinguish individual elements from other parts of the same picture as they do when they are reading paragraphs of text. Individuals consider a single visual element as a whole. Through the measurement of eye movement, the sequence of a subject’s reading of different visual elements can be captured to analyze the attention distribution.

Overall, the social distance of the journalistic picture samples shows a medium level of involvement of the viewer by image producers. The representative characteristics of the interaction between participants and the selected stimulus materials were

analyzed carefully through content analysis coding. According to visual grammar theory introduced by Kress and Leeuwen, four sets of codes were used for the two categories of journalistic pictures that served as stimuli [4]. The first and second sets of codes were “eye contact (human)” and “eye contact (represented as human)”, each of which included “with eye contact” and “without eye contact” subcodes. The third set of codes was “social distance”, which included the following subcodes: 1) “intimate distance”, 2) “close interpersonal distance”, 3) “far interpersonal distance”, 4) “close social distance”, 5) “far social distance” and 6) “impersonal distance”. The last set of codes was “attitude”, which contained five subcodes: 1) “horizontal angle”, 2) “high angle”, 3) “low angle”, 4) “frontal angle” and 5) “oblique angle”.

For example, for the first set of codes, because only 1/6 of the photos featured imagery that simulated eye contact with the viewer, so the viewer’s involvement level, as measured by “eye contact” with the image, was quite low across participants. Only 2 pictures (of the 12 pictures) involved eye contact with the viewer. Most of the journalistic pictures in the sample were not intended to evoke the attention of the viewer. The interactive meaning of this form of journalistic image production is therefore that the world represented in the picture is not important to the viewer or has no relationship with the viewer; thus, neither of the two types of journalistic pictures (nonfictional and fictional) strongly influenced the viewer.

The social distance of the images fell mainly in the categories of “far interpersonal distance” (3 of the 6 fictional journalistic pictures and 2 of the 6 nonfictional journalistic pictures) and “far social distance” (1 of the 6 fictional journalistic pictures and 3 of the 6

疫苗种类	二价HPV疫苗	四价HPV疫苗	九价HPV疫苗
预防的HPV亚型	16,18	6,11,16,18	6,11,16,18,31,33,45,52,58
	女性适合年龄 (只推荐女性)	女性适合年龄 男性适合年龄	女性适合年龄 男性适合年龄
美国妇产科协会	11-26岁	11-26岁 11-26岁	11-26岁 11-26岁
WHO	9-14岁	9-14岁 根据各地区情况 决定是否推荐	9-14岁 根据各地区情况 决定是否推荐
CFDA	9-25岁 (2018年5月改为9-45岁)	20-45岁	16-26岁
上市时间	2006年	2007年	2014年
中国内地上市时间	2016年7月	2017年6月	2018年4月28日
参考价格 (3针)	1740元	2394元	海南省中标价3894元 (博鳌和陆家5800元)
内地推荐的接种程序	3剂 (0、1和6月各一剂)	3剂 (0、2和6月各一剂)	3剂 (0、2和6月各一剂)
主要功能	预防70%的宫颈癌	预防70%的宫颈癌和90%的生殖器疣	预防92.1%的宫颈癌和90%的生殖器疣
能预防的疾病	HPV16、18型相关的宫颈癌 CIN 1 CIN 2/3 原位腺癌	所覆盖的四种基因型相关的宫颈癌 外阴癌和阴道癌 CIN 1 CIN 2/3 原位腺癌 VIN 2/3 女性: 阴道上皮内瘤变2/3 男性: 阴茎上皮内瘤变1/2/3, 阴茎癌 男性和女性: 疣 肛门上皮内瘤变 肛门癌	所覆盖的九种基因型相关的宫颈癌 外阴癌和阴道癌 CIN 1 CIN 2/3 原位腺癌 VIN 2/3 女性: 阴道上皮内瘤变2/3 男性: 阴茎上皮内瘤变1/2/3, 阴茎癌 男性和女性: 疣 肛门上皮内瘤变 肛门癌
预防效果	HPV16和18基因型相关的疾病 预防率98.1%	HPV6、11、16、18型相关疾病预防率将近100% 男性外生殖器疾病预防率90.4%	HPV6、11、16、18型相关疾病预防率超过99% HPV31、33、45、52、58型相关疾病预防率96.7%

Fig. 1. Heat map of HPV vaccine types.

Table 1
HPV vaccine introduction.

Vaccine types	Bivalent HPV vaccine	Tetravalent HPV vaccine		Nine-valent HPV vaccine	
HPV subtype	16, 18	6, 11, 16, 18		6, 11, 16, 18, 31, 33, 45, 52, 58	
American Obstetrics and Gynecology Association	Recommended age for females (only recommended for females) 11–26 years old	Recommended age for females 11–26 years old	Recommended age for males 11–26 years old	Recommended age for females 11–26 years old	Recommended age for males 11–26 years old
WHO	9–14 years old	9–14 years old	Recommendation determined based on local conditions	9–14 years old	Recommendation determined based on local conditions
CFDA	9–25 years old (changed to 9–45 years old in May 2018)	20–45 years old	–	16–26 years old	–
Time to market	2006	2007		2014	
Time to market in Mainland China	July 2016	June 2017		April 28, 2018	
Reference price (3 doses)	1740 CNY	2394 CNY		Hainan Province won the bid price of 3894 CNY (5800 CNY for Boao United Family Healthcare)	
Recommended vaccination procedures in Mainland China	3 doses (one each for 0, 1 and 6)	3 doses (one each for 0, 2 and 6)		3 doses (one each for 0, 2 and 6)	
Primary function	Prevents 70% of cervical cancers	Prevents 70% of cervical cancers and 90% of genital warts		Prevents 92.1% of cervical cancers and 90% of genital warts	
Preventable diseases	HPV 16- and 18-related cervical cancer CIN 1 CIN 2/3 Adenocarcinoma in situ	Four genotype-related cervical cancers Vulvar and vaginal cancer CIN 1 CIN 2/3 Adenocarcinoma in situ VIN 2/3 Females: Vaginal intraepithelial neoplasia 2/3 Males: Penile intraepithelial neoplasia 1/2/3, penile cancer Genital warts Anal intraepithelial neoplasia Anal cancer		Nine genotype-related cervical cancers Vulvar and vaginal cancer CIN 1 CIN 2/3 Adenocarcinoma in situ VIN 2/3 Female: Vaginal intraepithelial neoplasia 2/3 Male: Penile intraepithelial neoplasia 1/2/3, penile cancer Genital warts Anal intraepithelial neoplasia Anal cancer	
Preventive effect	HPV 16- and 18-related diseases Prevention rate is 98.1%	HPV 6-, 11-, 16-, and 18-related disease prevention rate of nearly 100% Male genital disease prevention rate of 90.4%		HPV 6-, 11-, 16-, and 18-related disease prevention rate exceeding 99% HPV 31, 33, 45, 52, and 58-related disease prevention rate of 96.7%	

nonfictional journalistic pictures). None of the pictures was characterized by “intimate distance”, which involves the viewer the most. In the two categories of journalistic pictures, one picture in each category featured “impersonal distance”, which involves the viewer the least.

The fourth set of codes was used to analyze the power relationship that the image producer was trying to construct. An explanation is provided in section 3.3.

3.3. Production of perceived power relationships in HPV-related images

Utilizing Kress and Leeuwen’s visual grammar theory, the researchers analyzed participants’ perceived power relations between the represented participants in the picture during the viewing process, as well as the intended viewpoint of the producer of the picture [4]. In Fig. 2, the power relationships between the viewer and the represented participants in the images are as follows (from left to right): viewer > represented participant; viewer = represented participant; and viewer < represented participant. A comparison of the pictures showed that in the low-angle pictures, the represented participant attracted most of the viewing participants’ attention. Instead of constructing a set of relationships, the participants focused the vast majority of their attention on the powerful vaccine sellers.

In terms of the acquisition of HPV-related information, regardless of how the power relationship between the represented participant and the viewer changed, the participants focused mainly on doctor-patient interactions in the nonfictional picture group. However, in the fictional picture category, the participants’

attention to the imaginary doctor-patient relationship changed significantly from a projection of themselves onto the relationship to more symbolic representations of the scarcity of the HPV vaccine. In the high-, horizontal- and low-angle fictional pictures, the participants’ fixated their gaze the longest on direct HPV health-related information.

The experimental results show that participants showed the most concern for diseases that can be prevented by the HPV vaccine, the prevention rate, and information concerning the nine-valent HPV vaccine, while they paid little attention to the price of the vaccine. In addition, they showed little concern for the price of the HPV vaccine across all categories and types of vaccines. Participants were more emotionally connected to images containing close-up images of the vaccination process (e.g., injections), images of people waiting in line for vaccinations, and images depicting the high price of the vaccine, and they were less emotionally connected to images portraying interactions between doctors and patients.

4. Discussion

4.1. The viewer: attention to the “similar other”

Some studies on persuasive visual health information have shown that the “similar other” can effectively strengthen the link between the represented participants in the picture and the viewer [5]. The analysis of the interview data showed that in the process of viewing images of staff-patient interactions, the participants projected their own imagination of themselves as participants in the picture, consistent with the “similar other” theory.

Based on the analysis of the fixation sequences, in the second

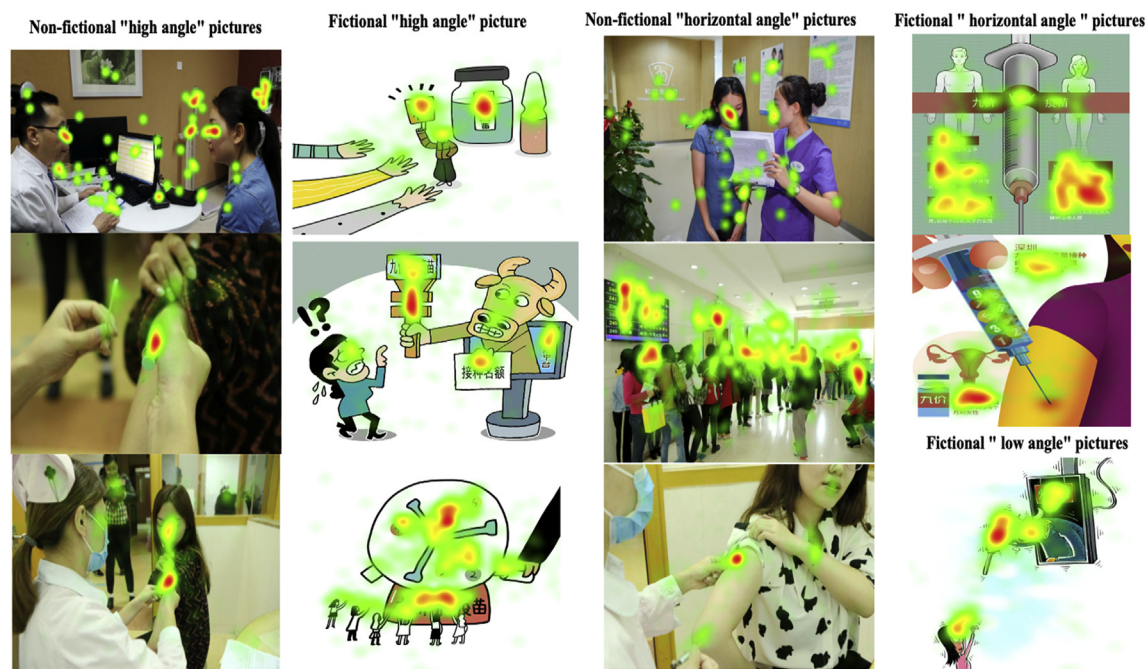


Fig. 2. Power relationships between the viewer and the represented participants in the images (From left to right: “high angle”, viewer > represented participant; “horizontal angle”, viewer = represented participant; and “low angle”, viewer < represented participant).

picture in the nonfictional picture set, the participants fixated the longest on the doctor’s computer and the patients but paid only half as much attention to the doctor. They also paid little attention to medical equipment and other items in the office, such as the medical records held by the doctor and the pictures hanging on the wall. Subjects fixated first on the patient, followed by the doctor’s computer, the doctor, the pictures hanging on the wall, medical records and medical equipment. In this case, the participants focused mainly on the patient in the picture.

This characteristics of the participants’ fixation sequences can also be seen in the power relationship analysis. In Fig. 2, regarding the different power relationships represented in the journalistic pictures, the heat map of the female graduate students’ attention shows that the students’ gazes were focused on the patients represented in the stimuli during the data collection procedure.

4.2. Persuasive visual health information: contradictory representation strategies

The analysis of the interactive meaning of the stimulus pictures revealed contradictory production strategies. On the one hand, the strategy of involving the viewer in positive interactions, such as through the use of the frontal angle (9 of the 12 pictures), was used; on the other hand, some other useful strategies for involving the viewer in interactions, for example, the use of eye contact with the represented participants and the creation of a close social distance, were neglected. This indicates that in mainland China, the health communication of the Chinese news media has remained in the very early stages. For medical departments, the dissemination of epidemic prevention knowledge has not prioritized. Therefore, HPV vaccine-related information and news reports are difficult to find on the official websites and social media accounts of the Chinese Women’s Federation, China’s relevant medical authorities and the mainstream Chinese media. The active communicating agents for HPV vaccine campaigns are private hospitals and commercial intermediaries in China. According to a media report, the vaccine is

still in short supply in China. Due to these circumstances, many Chinese women go to overseas to be vaccinated.

5. Conclusion

This study attempted to explain the mechanisms of individuals’ perception of persuasive visual health information. Twenty female undergraduate students were chosen to examine how a female audience viewed journalistic pictures related to the HPV vaccine from the largest Chinese online open image database, Visual China (www.vcg.com). To examine the link between the separate processes of image production and image viewing, the interactive meaning of the stimuli was coded following visual grammar theory. Other mixed methods, such as an eye tracking experiment, a questionnaire survey, and in-depth semi-structured interviews, were used to further investigate how females perceived the HPV vaccine pictures. To support the development of more practical strategies to administer persuasive visual health information, the stimuli were classified into three sets: an infographic, fictional journalistic pictures and nonfictional journalistic pictures.

The research data show that for the first set of stimuli, i.e., the infographic, the female participants focused most of their attention on information about the nine-valent HPV vaccine. The analysis of the interactive meaning of the two sets of journalistic pictures, i.e., the fictional and nonfictional pictures, showed that the image producers did not implement useful viewer involvement strategies to persuade the viewer.

Second, the researchers found that when female undergraduate students looked at journalistic pictures related to HPV, they first looked for the “similar other” in the pictures and then substituted themselves into an imaginary set of social relationships. In the sample of nonfictional pictures, the participants paid the most attention to the doctor-patient interaction. The study demonstrated that participants frequently focused on the doctor-patient interaction as the starting point when viewing the images.

Third, depictions of the scarcity of the HPV vaccine and the risk

of contracting the disease strongly captured the attention of participants. In the infographic and fictional pictures, female college students paid the most attention to information that was directly related to HPV and gazed at this information the longest.

Future research should focus on the interaction between health knowledge and social consciousness instead of relying on experts to disseminate medical information to the public. Regarding Chinese media image production, interactive meaning strategies that lead to higher viewer involvement, such as using more eye contact, creating a closer social distance, and providing more key information directly to the social groups that need the information the most, should be adopted. In terms of how females perceive visual health information, the questionnaire survey and in-depth semi-structured interviews indicate that further research is needed. Current visual persuasive information on the HPV vaccine needs further improvement due to the high demand for information about HPV from the Chinese female audience.

The development of a knowledgeable and healthy populace will be more likely if diverse agents of society can participate in the process of communicating important ideas effectively.

Funding

This research was supported by grants from the Fundamental Research Funds for the Central Universities 2021JBW104 (Patient Empowerment in the Context of Patient-Centered Communication).

Declaration of competing interest

Dr. Chen reports the receipt of grants and personal fees from the Fundamental Research Funds for the Central Universities during the conduct of the study. This funding did not affect the study design, data analysis or conclusions of this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijnss.2020.07.004>.

References

- [1] Wu QL, Xu Y, Zhang JY, Li DP, Yang ZC. Guangzhou female medical students awareness and cognition of human papillomavirus vaccination. *The Chinese school health* 2018;39(11):1699–701. <https://doi.org/10.16835/j.cnki.1000-9817.2018.11.028>.
- [2] Huang H, Zhao FH, Xie Y, Wang SM, Pan XF, Hui L, et al. A survey of college students' attitude towards HPV and its preventive vaccine in chengdu. *Mod Prev Med* 2013;40(16). 3071–3071, <http://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CJFD&filename=XDYF201316040&dbname=DJFD2013>.
- [3] Kelly BJ, Niederdeppe J, Hornik RC. Validating measures of scanned information exposure in the context of cancer prevention and screening behaviors. *J Health Commun* 2009;14(8):721–40. <https://doi.org/10.1080/10810730903295559>.
- [4] Kress GR, Van Leeuwen T. *Reading images: the grammar of visual design*. Routledge; 2006. p. P165–78. <https://www.routledge.com/Reading-Images-The-Grammar-of-Visual-Design-2nd-Edition/Kress-Leeuwen/p/book/9780415319157>.
- [5] King AJ. A content analysis of visual cancer information: prevalence and use of photographs and illustrations in printed health materials. *Health Commun* 2015;30(7):722–31. <https://doi.org/10.1080/10410236.2013.878778>.