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Development and validation of the Health Visual Information Preference Scale

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Objective. Patients are likely to have individual preferences for learning about health, which may influence their comprehension and utilization of health information. Some patients may prefer visual health information, which can make complex health information easier to understand. Aligning health information presentation with preferences may increase understanding and improve health outcomes, yet no scale measures preferences for visual health information.

Design. Two studies examined the psychometric properties of the Health Visual Information Preference Scale (Health VIPS), a new measure designed to assess preferences for visual health information.

Methods. In Study 1, 103 undergraduate students and 97 patients undergoing colorectal and gynaecological oncology surgery completed the Health VIPS. Exploratory factor analyses (EFA) were conducted for both samples. Internal consistency, test–retest reliability, and validity were assessed in the student sample. In Study 2, 196 outpatients completed the Health VIPS. Confirmatory factor analysis (CFA) was performed on this sample, in addition to measures of reliability and validity.

Results. In Study 1, EFA analysis suggested a two-factor structure. The Health VIPS demonstrated good internal consistency in both the student sample (α = .70–.80) and patient sample (α = .80), and good test–retest reliability in the student sample (r = .63, p < .001). Convergent validity and discriminant validity were also established. In Study 2, the CFA confirmed a two-factor structure is the best model fit for the Health VIPS. The Health VIPS also demonstrated discriminant and convergent validity. Scale item means in all samples were positively skewed, suggesting a general preference for visual health information.

Conclusions. Initial evidence suggests the Health VIPS has good psychometric properties. This scale could identify patients who would benefit from additional visual aids when receiving health information.

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Statement of contribution

What is already known on this subject?

- Poor comprehension of health information can lead to misunderstandings of illness and treatment, and potentially non-adherence.
- It is likely that patients have distinct preferences for how they would choose to receive health information, including information format.
- Visual health information is becoming more widely used to communicate information about health and illness to patients, although there is no measure to identify those who prefer this information format to standard written health materials.

What does this study add?

- This study describes the first scale to assess preferences for visual health information.
- This scale could identify patients who would benefit from supplementary visual information in consultations.

Delivering health information effectively to patients is an integral component of health care utilization. The effective translation of health information from provider to patient should improve the likelihood that treatment recommendations evolve into adherence. Effective comprehension, however, can be difficult to achieve for many reasons, including factors of the clinical environment such as short consultation times and the intrusion of psychological and physical symptoms (Houts, Doak, Doak, & Loscalzo, 2006). Furthermore, physicians often overestimate patients' abilities to comprehend the information they conveyed during a consultation (Kelly & Haidet, 2007). This becomes problematic as misunderstandings of health information impair the ability of the patient to apply recommended treatment and lifestyle changes to promote health.

One approach that may increase the comprehension and utility of health information could be matching information delivery with the patient's preferred information format. It is likely that idiosyncrasies exist regarding how patients would prefer health information to be delivered, which could influence their health behaviours. Evidence from health risk evaluation and decision-making research indicates that different methods of presenting risk result in differing evaluations and use of that information (Peters, Dieckmann, Dixon, Hibbard, & Mertz, 2007; Schapira, Nattinger, & McAuliffe, 2006). Indeed, the framing and packaging of information, particularly when unfamiliar and complex, can influence how that information informs choice (Peters *et al.*, 2007). The medical encounter constitutes an unfamiliar and often complex scenario for most patients, meaning the 'packaging' and format of health information may influence understanding and subsequent behaviour.

In the health care setting, standard verbal explanations are generally supplemented with written materials such as pamphlets, medication inserts, and other printed instructions (Ngoh & Shepherd, 1997). Written health information may be helpful for patients with the capacity to read, understand, and remember that information (Hoffmann & Worrall, 2004). However, not all patients attend well to written health materials (Webster, Weinman, & Rubin, 2017; Williams, Baker, Parker, & Nurss, 1998), especially those with lower comprehension and literacy skills (Brotherstone, Miles, Robb, Atkin, & Wardle, 2006; Kessels, 2003). Poor health literacy is common. The lay public also demonstrates difficulties in understanding medical terminology, even with terms that are commonly used within the health care context (Smith, Trevena, Nutbeam, Barratt, & McCaffery, 2008). Furthermore, research shows that patients often have only rudimentary knowledge of their anatomy and bodily processes (Weinman, Yusuf, Berks, Rayner, &

Petrie, 2009). Considering these widespread issues with health literacy, it is likely that for some patients written health information is a barrier to understanding and utilizing health information and advice.

Patients may prefer to receive visual information about illnesses and treatments, particularly those who struggle with health literacy or who are cognitively aligned to best understand visual representations of information (Houts *et al.*, 2006; Peregrin, 2010). Visual depictions of health risk material are often preferred by patients (Edwards, 2002; Goodyear-Smith *et al.*, 2008) and can increase both understanding and health risk perceptions (Galesic, Garcia-Retamero, & Gigerenzer, 2009; Lipkus & Hollands, 1999). Patients with both high and low literacy value the inclusion of anatomical images in health materials (Smith *et al.*, 2008), and the ability of visual images to explain 'invisible' anatomical processes (Carlin, Smith, & Henwood, 2014; Devcich, Ellis, Waltham, Broadbent, & Petrie, 2014; Vilallonga *et al.*, 2012). Visual tools and interventions have become increasingly popular methods for communicating health information to patients (Jones, Ellis, Nash, Stanfield, & Broadbent, 2016; Jones, Fernandez, Grey, & Petrie, 2017; Jones *et al.*, 2018; Perera, Thomas, Moore, Faasse, & Petrie, 2014; Phelps, Wellings, Griffiths, Hutchinson, & Kunar, 2017; Rees *et al.*, 2013; Stephens *et al.*, 2016). However, it is yet unclear how many patients prefer this style of information, and whether all, or only certain, individuals respond better to information delivered this way.

Despite the likely existence of distinct preferences for health communication, to our knowledge, no measure exists to assess preference for supplementary visual health information. There is considerable research on learning styles and identifying 'visual learners' (Childers, Houston, & Heckler, 1985; Fleming & Mills, 1992; Kirby, Moore, & Schofield, 1988; Richardson, 1977); however, there is an important distinction to be made. Measures of learning style abilities do not assess information preferences. These measures are concerned with identifying where the responder sits in regard to different cognitive styles (e.g., visual vs. verbal learner). There is no scale to identify patients with heightened preferences for receiving health information visually. Being able to identify patients with a visual health preference could ensure that additional information is provided in this format, which may increase comprehension and adherence to recommendations.

In this paper, we report on the development of a measure identifying preferences for receiving visual health information. This measure may help to identify patients who prefer and additionally respond better to visual explanations of health material in clinical settings. We report on the psychometric properties of the Health Visual Information Preference Scale (Health VIPS). Study 1 reports the results of exploratory factor analyses (EFA) conducted with both healthy and clinical samples, and Study 2 reports the results of a confirmatory factor analysis (CFA) completed with a sample of outpatients attending hospital medical clinics.

STUDY 1

Method

Participants

Two independent samples completed the Health VIPS. The healthy sample comprised 103 undergraduate students from the Faculty of Medical and Health Sciences at the University of Auckland, studying between October and December 2017. The clinical sample consisted of 97 patients undergoing elective colorectal and gynaecological oncology surgery at Auckland City Hospital between July 2017 and July 2018, who completed the Health VIPS in a questionnaire battery as part of another clinical trial. Included participants spoke English, were over 18 years of age, and had no known mobility issues (as relevant to the clinical trial).

Procedure

The student sample was recruited by either a cohort email sent to a stage one health psychology course, or by Facebook invite in a medical student group. Participants received no compensation for taking part in the research. Respondents completed the questionnaire electronically by following a link to the website SurveyMonkey Inc. (2017) and provided informed consent before beginning the questionnaire. Participants answered demographic questions (age, gender, highest level of education), followed by the Health VIPS and other validation measures (reported below). Participants were emailed 2 weeks later and asked to re-complete the questionnaire for test–retest reliability assessment. Test–retest reliability was conducted in the student sample only, as the clinical sample was undergoing surgery and this intervention could have influenced test–retest reliability in this sample. The study was approved by the University of Auckland Human Participants Ethics Committee.

The clinical sample completed the Health VIPS as part of a baseline battery of measures collected at their surgical pre-admission appointment. Ethics approval was gained for this study from the Health and Disability Ethics Committee and the Auckland District Health Board.

Health Visual Information Preference Scale items

To create the initial Health VIPS item pool, the authors AJ, MK, LM, KP reviewed the literature for existing scales attempting to assess visual learning preferences. Items were developed using a mixture of methods, including expert consultation from study authors to generate items, and reviewing two learning preference scales (Fleming & Mills, 1992; Kirby *et al.*, 1988) for examples that could be used as a style guide for item wording. Each author was instructed to develop 5–6 items that considered the use of different types of visual health information (e.g., diagrams, illustrations, scans) in different medical settings where information is commonly provided (e.g., surgical preparation, treatment initiation, consultations). These items comprised a raw pool of 22 items. The authors consulted and removed items from this list that had obvious overlap and addressed similar content from a face validity perspective, which resulted in an initial 12-item scale used for pilot testing.

This 12-item initial version was piloted with 45 postgraduate health psychology students at the University of Auckland, and undergraduate psychology students from La Sierra University, California and Philipps-University of Marburg, Germany. Reliability analysis of this data revealed that removing three items would not decrease Cronbach's alpha for the scale, while removing any of the other items would reduce this (e.g., from $\alpha = .84$ to .81). These three items were removed from the scale, which resulted in the final nine-item measure.

The Health VIPS asks respondents to rate the degree to which they agree or disagree with each item (full item list can be found in Table 1) on a Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'), with three reverse-coded items (items 4, 7, and 9). Total scores are calculated by averaging the items. The tool was designed to measure a single dimension where lower scores indicate less preference and higher scores indicate

Table 1. Mean and standard deviations of each Health Visual Information Preference Scale item across the study samples

	Study 1 (exploratory factor analyses samples)		Study 2 (confirmatory factor analysis sample)
	Student sample (N = 103) *M* (*SD*)	Patient sample (N = 94) *M* (*SD*)	Outpatient sample (N = 196) *M* (*SD*)
1. Being shown a scan or an image of the inside of my body would help my understanding of a medical condition	4.30 (0.79)	4.46 (0.80)	4.44 (0.87)
2. I often find that medical information that uses words, but no pictures, is harder to follow	3.78 (0.91)	3.43 (1.11)	3.41 (1.12)
3. When it comes to understanding health information, I find an image is worth a thousand words	3.79 (0.88)	4.05 (1.05)	3.86 (1.03)
4. I am the sort of person who doesn't need visual aids (e.g., pictures, diagrams) to understand medical information*	3.37 (1.03)	3.49 (1.05)	3.31 (1.12)
5. If I were newly diagnosed with an illness, seeing animations or images would help me to create a picture of what the illness 'looks like'	4.27 (0.78)	4.09 (0.95)	4.07 (0.90)
6. If I needed to have surgery, a visual illustration of the operation would help me to better understand the procedure	4.35 (0.87)	3.97 (1.05)	4.13 (1.00)
7. I prefer a straightforward verbal or written explanation of an illness to one that includes illustrations*	3.38 (1.13)	3.27 (1.28)	3.01 (1.14)
8. If I was prescribed a new medicine, being shown a visual demonstration of how the medicine worked inside the body would be helpful for my understanding	3.54 (1.22)	3.34 (1.22)	3.51 (1.10)
9. When my doctor gives me health information, I prefer a simply written document rather than one with added pictures or diagrams*	3.64 (0.96)	3.21 (1.10)	3.09 (1.11)

*Reverse-coded items.

stronger preference for visually presented health information. Items compare receiving visual information with written information, as this is the standard form of supplementary material used in health care.

Validation measures

Style of Processing – Picture subscale

The Style of Processing picture subscale (SOP-P) (Childers *et al.*, 1985) was used to assess convergent validity of the Health VIPS. The SOP scale aims to assess preference for imaginal processing. We used the 11-item picture subscale only, as the verbal subscale items were irrelevant. The response scale for the SOP-P consists of four anchored response points ranging from 1 ('always true') to 4 ('always false'), with one reverse-coded item. Example items include 'When I'm trying to learn something new, I'd rather watch a demonstration than read how to do it' and 'My thinking often consists of mental "pictures" or "images"'. Higher scores reflect less preference for visual processing; therefore, we would expect a negative correlation with the Health VIPS.

BRIEF health literacy screening tool

The BRIEF health literacy screening tool (BRIEF) (Haun, Luther, Dodd, & Donaldson, 2012) was used to assess discriminant validity. The BRIEF health literacy screening tool is a four-item measure of health literacy which asks respondents four questions about health comprehension, and their confidence in understanding health information and completing tasks. Items 1–3 are answered using anchored responses from 'always' to 'never', and anchors 'not at all' to 'extremely' are used for item 4. Higher scores represent greater health literacy. We expected no correlation between the BRIEF and Health VIPS, indicating two distinct measurement constructs.

Statistical analyses

Descriptive statistics and reliability and validity analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). The strength of correlations was used to assess test–retest reliability, and convergent and discriminant validity.

The EFA used maximum-likelihood estimation applied to the polychoric correlation matrix, which was conducted using Stata 15.1 (StataCorp LLC, College Station, TX, USA). To verify the appropriateness of the sample for performing a factor analysis, we examined the item and overall measures of sampling adequacy. According to Kaiser and Rice (1974), items with a measure of sampling adequacy below .50 should be excluded from the questionnaire and further analyses; none of the items were eliminated based on this criterion. In addition, we calculated the overall Kaiser–Meyer–Olkin sampling adequacy coefficient and performed a Bartlett test of sphericity to assure that the data set was suitable for factor analysis. Due to the fact that principal components analysis with Kaiser criterion is an error-prone extraction method, where the number of extracted factors may be overestimated (Costello & Osborne, 2005), Horn's parallel analysis (1965) was used to determine the number of factors to extract. Parallel analysis is based on the assumption that significant factors or components from observed study data have larger eigenvalues than those obtained from a random data set with the same sample size and number of variables (Crawford *et al.*, 2010). Direct oblimin rotation was applied to the loadings on the extracted factors. Reliability analysis was used to test internal consistency of the scale, with satisfactory target values set at .70 (Bland & Altman, 1997; Nunnally, 1978), although scales with fewer items tend to have smaller values (Tavakol & Dennick, 2011).

Results

Undergraduate student sample

Sample characteristics

Of the 106 students who opened the questionnaire link and began responding, 103 fully completed the Health VIPS and were retained in the sample (97.2% completion rate). Participants ranged from 18 to 50 years of age (M = 20.99, SD = 5.09), were mostly female (78.6%, 81/103), and reported having completed at least secondary level education (59.2%, 61/103), with some also having completed tertiary (35%, 36/103) or postgraduate study (5.8%, 6/103).

Exploratory factor analyses

No item had a measure of sampling adequacy coefficient below .50. A Kaiser–Meyer–Olkin coefficient of .67 indicated that the items were amenable to factor analysis. The Bartlett test of sphericity also affirmed that this data set was suitable for structure detection, $\chi^2_{(36,N=103)} = 167.60$, $p < .001$. Parallel analysis indicated a three-factor solution. The three-factor solution explained 64% of the total variance. The rotated pattern of factor loadings (Table 2) indicated items 1, 2, 3, and 8 formed a factor, items 5 and 6 formed a factor, and the negatively phrased items 4, 7, and 9 formed a factor. Factors 1 and 2 had a strong positive correlation (r = .44) and factor 3 had weak negative correlations with Factors 1 and 2 ($r = -.34$ and $-.08$, respectively).

We repeated the EFA with data collected at follow-up. No items had a sampling adequacy coefficient below .50. A Kaiser–Meyer–Olkin coefficient of .81 indicated very good applicability of the residual sample of items for factor analysis, and again the Bartlett test of sphericity affirmed this data set was suitable for applying EFA, $\chi^2_{(36,N=83)} = 191.26$, $p < .001$. Parallel analysis this time indicated a two-factor solution that explained 57% of the total variance. The pattern of item loadings was similar to that in the baseline data but combined items 1, 2, 3, 5, 6, 8 into a single factor (Factor 1), that correlated negatively with a second factor consisting of items 4, 7, and 9 (Factor 2; $r = -.65$).

Reliability and validity

Descriptive statistics revealed a positive skew in scale item responses (see Table 1). The average mean total score of scale items was 3.82 (SD = 0.52). The Health VIPS total score demonstrated good internal consistency at both baseline (α = .70) and follow-up (α = .80). At follow-up, 83 of the 103 students completed the Health VIPS (80.6% retention rate), between 14 and 34 days after the initial assessment (M = 17.84, SD = 5.44). The Health VIPS score demonstrated moderate test–retest reliability, reflected by a significant, positive correlation between baseline and follow-up data for the total scale (r = .63, $p < .001$). As predicted, the total Health VIPS correlated negatively

Table 2. Factor loadings and uniqueness for Health Visual Information Preference Scale items in the student and patient samples

	Student sample (n = 103)				Patient sample (n = 97)		
	Factor 1	Factor 2	Factor 3	Uniqueness	Factor 1	Factor 2	Uniqueness
1. Being shown a scan or an image of the inside of my body would help my understanding of a medical condition	0.61	0.13	−0.02	0.69	0.73	0.16	0.53
2. I often find that medical information that uses words, but no pictures, is harder to follow	0.56	−0.09	0.04	0.62	0.47	0.04	0.79
3. When it comes to understanding health information, I find an image is worth a thousand words	0.75	−0.07	0.01	0.38	0.88	0.07	0.28
4. I am the sort of person who doesn't need visual aids (e.g., pictures, diagrams) to understand medical information	−0.15	0.59	0.25	0.59	−0.22	0.25	0.84
5. If I were newly diagnosed with an illness, seeing animations or images would help me to create a picture of what the illness 'looks like'	0.10	0.12	0.63	0.58	0.83	−0.12	0.22
6. If I needed to have surgery, a visual illustration of the operation would help me to better understand the procedure	0.00	−0.15	0.72	0.40	0.85	−0.04	0.24
7. I prefer a straightforward verbal or written explanation of an illness to one that includes illustrations	−0.02	0.65	−0.18	0.48	−0.07	0.48	0.74
8. If I was prescribed a new medicine, being shown a visual demonstration of how the medicine worked inside the body would be helpful for my understanding	0.35	0.02	0.25	0.68	0.57	−0.22	0.53
9. When my doctor gives me health information, I prefer a simply written document rather than one with added pictures or diagrams	−0.01	0.55	−0.15	0.63	−0.01	0.87	0.23

with the SOP-P both at baseline ($r = -.32, p = .001$) and follow-up ($r = -.41, p < .001$), demonstrating convergent validity. No significant correlation was found between the BRIEF health literacy scale and Health VIPS total score at either baseline ($r = -.06$, $p = .541$) or follow-up (total score $r = -.18, p = .121$) demonstrating good discriminant validity.

Clinical sample

Sample characteristics

Of 123 patients approached, 97 completed the baseline questionnaire for the trial. Patients were excluded for not meeting the larger trial inclusion criteria ($n = 4$) or for declining participation ($n = 22$). Of those 97 participants, 94 completed the Health VIPS as part of the baseline questionnaire. The majority of the clinical sample was female (62.9%, 61/97) and New Zealand European or European (71.1%, 69/97), ranging in age from 18 to 91 years old ($M = 58.60$, $SD = 16.39$).

Exploratory factor analyses

No item had a measure of sampling adequacy coefficient below .50. A Kaiser–Meyer–Olkin coefficient of .78 indicated very good applicability of the residual sample of items for factor analysis. Bartlett's test of sphericity was again highly significant and confirmed that the data set is suitable for being analysed with a factor analysis, $\chi^2_{(36,N=94)} = 274.61$, $p < .001$. Parallel analysis confirmed a two-factor structure within the patient sample. As with the student sample, items 1, 2, 3, 5, 6, 8 formed one factor (Table 2) that correlated negatively with a second factor consisting of item 4, 7, and 9 ($r = -.39$). The descriptives for this sample revealed a positive skew in responses to each item (see Table 1), and the average mean scale score was 3.66 ($SD = 0.69$). The patient sample demonstrated good internal consistency in the total scale ($\alpha = .80$).

STUDY 2

Method

Participants and procedure

The questionnaire was completed by 204 outpatients who were attending specialist services at Greenlane Clinical Centre, the main outpatient centre for Auckland City Hospital, New Zealand. Patients in the waiting room were consecutively approached by the research assistant who invited them to complete an anonymous questionnaire assessing preferences for health information. Patients were excluded if they did not speak English or were not interested in participating. Patients completed the questionnaire in the waiting room and returned the completed questionnaire to the research assistant before leaving. Ethical approval for the study was received from the Auckland Health Research Ethics Committee and the Auckland District Health Board Research Office.

Measures

In addition to the Health VIPS and demographic items (age, gender, ethnicity, level of education, and outpatient service), participants also answered additional measures to assess validity. Following the results from Study 1, the authors chose to include different validity measures to further assess relationships between the Health VIPS and other constructs, which are outlined below.

Preference test

To test preferences for health information using an example, participants saw a single page divided into two depictions of the same information in both picture and text format. This information was adapted from an instruction leaflet for self-injecting insulin. Patients ticked a box indicating their preference for either the written or pictorial information option. This item assessed convergent validity of the Health VIPS for establishing health information preference.

Self-rated health

A one item self-rated health question assessed discriminant validity of the Health VIPS. This item asks participants to rate their health compared to other people their age on a 10-point scale ranging from poor to excellent.

Health confidence

A two-item health confidence tool (Wasson & Coleman, 2014), measuring patients' confidence with managing their health and with health information, was used to assess convergent validity. Each item asks patients to rate their response from 0 to 10, with higher scores reflecting more confidence.

Satisfaction with health care

One item from the General Satisfaction subscale of the Patient Satisfaction Questionnaire (PSQ-18) (Marshall & Hays, 1994) was used to assess convergent validity. Responses to the statement 'The medical care I have been receiving is just about perfect' are rated on a 5-point scale (strongly agree to strongly disagree).

Experience with health information

One item asked patients to select whether the majority of supplementary health information they have received in the past has been given in either a written or visual format. This item was used to assess convergent validity, by creating a variable reflecting match between preference and experience, and assessing the relationship between this and health confidence and satisfaction with health care.

Statistical analyses

In accordance with recommendations for scale development (Byrne, 2016), a CFA within the structural equation framework was also applied to test the underlying factor structure of the Health VIPS in the outpatient sample. All tests were conducted using Stata 15.1 using maximum-likelihood estimation with a logit link function to account for the ordinal nature of the response scale. CFA models with one and two factors were considered since a unidimensional solution was initially hypothesized but a two-factor solution was shown to provide a more parsimonious empirical explanation of the interitem correlations. In addition, to these models a bifactor model was assessed since this approach allows for the consideration of a general factor, which might explain a two-factor solution where one is expected (Reise, Moore, & Haviland, 2010). To indicate goodness of fit for the model, we used the BIC, RMSEA, CFI, TLI, and chi-square to degrees of freedom ratio indices. Good fit is indicated by values under .06 for RMSEA, values above .90 for CFI, and values close to .95 for TLI (Hu & Bentler, 1999). The standardized regression coefficient is reported for each item. Reliability analysis assessed internal consistency of the scale, in addition to reporting McDonald's omega reliability estimate. Omega hierarchical was also reported for the bifactor solution as an indicator of the saturation of the scale by a general factor. Assumptions of convergent and discriminant validity were made by assessing the strength of correlations, or significance of independent samples *t*-tests.

Results

Sample characteristics

Of those participants who specified the service they were attending, most patients were attending surgical pre-admission (20.3%, 40/197), urology (19.8%, 39/197), orthopaedics (18.8%. 37/197), general surgery (11.7%, 23/197), or renal services (9.6%, 19/197). Other services included rheumatology (6.1%, 12/197), colorectal (3.6%, 7/197), gastroenterology, oncology and pain (all 2.0%, 4/197), neurology (1.5% 3/197), liver (1.0%, 2/197), and genetics, haematology, or nutrition (all 0.5%, 1/197). The majority of respondents were male (122/201, 60.7%). Most participants identified as NZ European or European (61.6%, 125/203), and most had completed at least secondary (82/201, 40.8%) or tertiary (74/201, 36.8%) education.

Confirmatory factor analysis

The authors compared the fit of one-factor, two-factor, and bifactor models. The BIC for the two-factor model was lowest indicating that this model provided the most parsimonious fit to the data: 4626.3 compared to 4712.8 for the one factor and 4628.7 for the bifactor. While the fit for the bifactor model was only marginally worse than for the two-factor model, omega hierarchical (ω_h = .50) indicated the level of saturation of the total score by a general factor was low indicating that treating the scale as sufficiently unidimensional was inappropriate. Together this provides support for the two-correlated factor model observed in the samples in study 1. Factor loadings are presented in Figure 1. The fit of the two-factor model was acceptable (RMSEA = .08; CFI = .91; TLI = .87). Factor 1 (items 1, 2, 3, 5, 6, 8) was labelled as preference for additional visual information. Factor 2 (Items 4, 7, 9) was labelled satisfaction with standard health information.

Reliability and validity

Mean scores of the Health VIPS items again suggested an overall positive skew (see Table 1), and the average of items was 3.63 (*SD* = 0.57). The Health VIPS scale demonstrated good internal consistency (α = .70). Coefficients suggested Factor 1 had good reliability (α = .83, omega = .88) and Factor 2 had moderate reliability (α = .60, omega = .71). The preference test demonstrated good convergent validity, whereby those who selected the pictorial information had significantly higher total scores on the

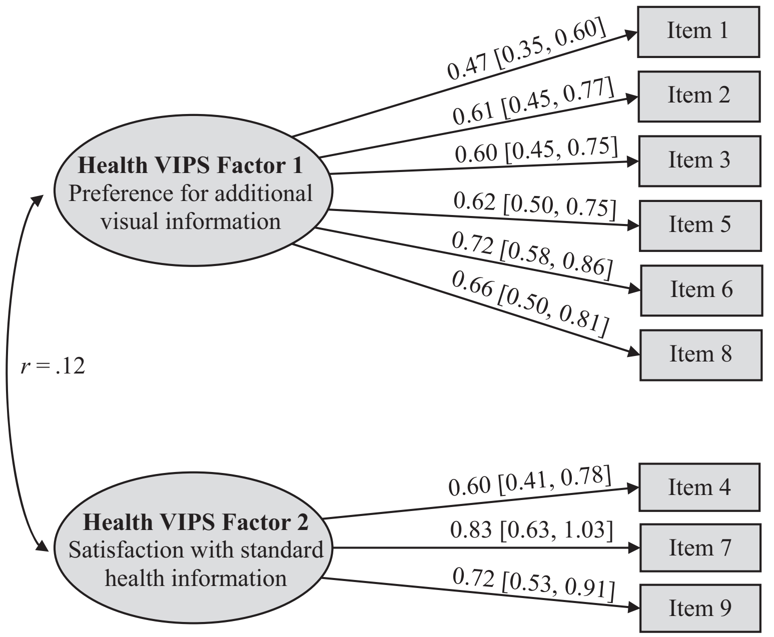

Figure 1. Confirmatory factor analysis of a correlated two-factor model of the Health Visual Information Preference Scale (values in square brackets indicate lower and upper limit of the 95% confidence interval; $N = 204$).

Health VIPS ($M = 34.07$, $SD = 4.83$) compared to those who selected the text option, $M = 31.43$, $SD = 5.20$; $t_{(160)} = -3.33$, $p = .001$. To assess convergent validity, we calculated, for participants in the upper and lower quartiles of the Health VIPS total score, a binary variable indicating (mis)match of experience with health information and *preference* for modality of health information. Differences between these groups in scores on the health confidence and health satisfaction measures were then assessed. Individuals with a mismatch had significantly lower health confidence ($M = 6.18$, $SD = 2.02$), compared to those without no mismatch, $M = 7.14$, $SD = 2.04$; $t_{(99)} = 2.33$, $p = .022$. Those with a mismatch also trended towards being more dissatisfied with their medical care ($M = 2.21$, $SD = 0.99$), than those with a match ($M = 1.90$, $SD = 1.07$), although this did not reach significance, $t_{(99)} = -1.50$, $p = .137$. A weak, negative relationship was found between the Health VIPS and self-rated health ($r = -.14$, $p = .043$), thus demonstrating discriminant validity.

GENERAL DISCUSSION

These studies assessed a new measure of patients' preferences for receiving supplementary visual health information. Overall, the results suggest that the Health VIPS is a brief, reliable, and informative instrument for assessing visual health information preferences. The tool demonstrated good psychometric properties, including internal consistency across samples. The Health VIPS also demonstrated good test–retest reliability, discriminant validity to measures of health literacy and self-rated health, and convergent validity with a non-health-related measure of visual processing style and a measure of health information preference. These results suggest that the Health VIPS is assessing distinct constructs, specific to the health context.

The EFA suggested that the Health VIPS has a two-factor structure, which was confirmed by the CFA analysis. These two separate factors have been defined as a preference for additional visual information and a satisfaction with standard health information. The second factor consists of the reverse-coded items. These reverse-coded items did appear to load problematically in some samples included in the EFA analysis of Study 1. However, removing these items from the scale resulted in further reduced model fit, suggesting that these items are important to retain. These reverse-coded items additionally serve an important purpose in preventing acquiescent responding and allowing the potential for different levels of preferences to be identified by the Health VIPS. This is important considering that most people would like the addition of visual information, which would likely diminish variance in this construct. Therefore, while the factor structure of the measure suggests two subscales, the authors still suggest utilizing the total score for clinical application of the scale. In this case, the total score can be considered to be the amount that the individual prefers added visual information compared to standard information alone.

It is reasonable that the Health VIPS performed differently in the three independent samples across the two studies. Participants in each sample had different experiences and histories with health information. The student sample likely had limited experiences with health information as patients. The two patient samples were also distinct. The patient sample in Study 1 was currently undergoing a medical procedure (surgery), whereas the Study 2 outpatient sample was undergoing diagnostic investigations or regular check-ups. Preferences and scores on the Health VIPS are likely to be distinct between those with differing levels of exposure to health information.

This study is limited by several factors. First, the student samples used for initial scale piloting, the EFA, and to assess test–retest reliability were relatively homogenous samples of undergraduate and postgraduate students studying medical and health sciences. This sample is not representative of the general population or patients and medical and health science students specifically may have a different understanding and approach to learning about biological processes in comparison to the lay public. Including patients in scale development may have provided more representative feedback of scale items and appropriateness of wording. The EFA conducted in the patient sample, however, did yield similar results. Second, we assessed convergent but not predictive validity for the Health VIPS. It would have been interesting to see if Health VIPS scores also predicted health information preferences assessed at a later point in time. Third, the amount of variance explained by the factors of the Health VIPS in the EFAs performed in Study 1 could be considered low (between 57% and 64%). This could be the result of smaller sample sizes; however, it has been noted that in social science research it is not uncommon to consider lower amounts of variance explained satisfactory (Hair, Black, Babin, & Anderson, 2014). In this instance, decisions regarding factors to retain should also include considerations of theoretical content.

Despite these limitations, there are clinical implications for the tool. Firstly, delivering visual health information to those with increased preferences could improve patient understanding and subsequent health behaviours. Research on health risk information suggests that the format of information may influence actual medical decision-making, by influencing patients' knowledge attainment (Hawley *et al.*, 2008). Visual information can increase patient attention, comprehension, and retention (Brotherstone *et al.*, 2006; Mintzer & Snodgrass, 1999), making patients more likely to adhere correctly to physician recommendations. These effects could be heightened further if patients prefer receiving health information visually. Our results did reveal that a match between format preference and experience was associated with greater health confidence, which may be an important factor in patient engagement and adherence.

The Health VIPS is brief and quick to complete, meaning it could easily be administered before a clinical consultation. The second study demonstrated that patients could complete the tool while waiting for an outpatient appointment. Health care providers could use the Health VIPS to screen patients and identify those who would benefit most from receiving supplemental visual aids during clinical consultations. Visual tools could be easy to incorporate into the clinical setting due to their low cost and portability (Jones *et al.*, 2016, 2017). Furthermore, diagnostic scans and images are often available in certain specialities (such as cardiology) but are underutilized as tools for patients (Devcich *et al.*, 2014). Visual materials may therefore already exist that could be easily incorporated into explanations for patients with a visual preference. The scale may also be useful to inform clinical staff what the proportion of their patient group is who would prefer visual information and how their patient information aligns with this group.

The Health VIPS may also be particularly useful in the health care setting for patients with low literacy levels. Patients are unlikely to disclose literacy problems for fear of embarrassment (Parikh, Parker, Nurss, Baker, & Williams, 1996). Importantly, patients with literacy problems are likely to be those most in need of health advice (Michielutte, Bahnson, Dignan, & Schroeder, 1992), but least likely to adequately comprehend traditional written material (Kessels, 2003). The Health VIPS could therefore be a way to sensitively measure preferences for visual health information, without relying upon patient disclosure of literacy problems or issues with understanding material. Furthermore, future research could also assess whether the Health VIPS is associated with the comprehension of health information, as this would highlight the importance of this tool for improving the utilization of health information.

Notable, when looking at all three samples, is the positive skew of scale responses suggesting a general preference for visual health information. This is perhaps unsurprising, yet an important consideration seeing as the default format for health information has been written material (Ngoh & Shepherd, 1997). Patient health information often neglects the inclusion of visual aids (Fagerlin *et al.*, 2004), although patients appear to prefer this format. Clinicians should therefore consider the format of supplementary health materials, and more broadly how incorporating visual aids and tools into their practice may improve patient education and outcomes.

To conclude, the Health VIPS is a short, reliable scale which appears to validly measure patient preferences for visual information about health. Clinically, this tool could be especially useful for increasing understanding and promoting health behaviour. Understanding patient preferences is an important aspect of health care, as aligning patient preferences with information delivery may also increase satisfaction and promote autonomy within the medical consultation. Further research should aim to replicate these results to understand if this construct can be reliably measured in other health populations.

Conflicts of interest

All authors declare no conflict of interest.

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