Can colour enhance emotional well-being in a primary care non-clinical consulting room? – A mixed-method study

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The potential for colour to influence human emotion and behaviour has received considerable attention in the research community, and more recently, extended to the applied use of colour in the healthcare environment. Although the evidence for colour application in the specialist mental health consulting room is diverse and evaluations infrequent, in context of an occupational transaction, it is proposed that colour and design affect a sense of emotional well-being, and potentially, health outcomes. The purpose of this work, a pragmatic, mixed method parallel design was to ask the question, 'can colour enhance emotional well-being in a primary care non-clinical consulting room'? Two strands were implemented sequentially, with some cross over. The experimental hypothesis predicted that colour would have an effect on emotional well-being. Quantitative data was collected with Likert type questions measuring response towards wall colour in a UK general medical surgery specialising in hard to reach communities. Three semi-structured focus groups explored qualitatively and quantitatively a sense of emotional well-being in response to interior room colour (n=8). Application of colour as intervention enabled post-test questionnaire (n=18) data to be collected. A limitation of this study is the sample size. However, the strength is potential value for similar specialist surgeries or healthcare environments. Meta inferences indicate that applied colour can enhance emotional well-being, and extensive use of off-white is not recommended without consideration to seating and visual detail. Significance was found for age, depression, and participation in focus groups, which warrants further research.

Introduction

During a primary care healthcare appointment for disadvantaged individuals, an occupational transaction is a complex set of interactions and relationships experienced as an integrated past, present and future [1]. Improving access for disadvantaged individuals is a priority and innovative ways are sought to engage and implement intervention [2-3]. One approach is evidence based healthcare design (EBD), utilising research to achieve best possible outcomes [4]. However, there appears minimal guidance available for general practice, (GP) [5] particularly specialist services prioritising social inclusion and mental health.

Currently, EBD colour application is connected with visual, aesthetic, and technical aspects of the environment and encompasses individual biological difference within the wider culture, so although rigorous colour guidelines are lacking [6-7] designers and healthcare professionals attempt Universal Principles [8] to promote inclusivity and well-being. Well-being is a psychosocial phenomena linking with mental health and inclusion [9]. Personal well-being has five components, of which emotional well-being is one component.

Measuring emotional well-being, defined as 'positive feelings and absence of negative feelings' [10] can contribute to EBD research [11]. Real world [12] and simulated [13] research investigates colour within EBD, however, real world research with practical application of colour to support a sense of emotional well-being as part of the occupational transaction is not readily available. Therefore, the purpose of this two strand mixed method design is use of a parallel design to ask the question 'can colour enhance emotional well-being in a primary care non-clinical consulting room'?

The study has five objectives: (1) identify current practice guidelines; (2) collect and statistically analyse pre and post emotional well-being response to wall colour; (3) collect, and qualitatively analyse well-being response to A2 colour samples; (4) apply mixed-method analysis to explore relationship with colour as part of occupational transaction, and (5) make recommendations for practice.

Background

As part of the healthcare appointment, an occupational transaction is acknowledged to be uncertain, [14] aesthetics contribute to the experience [15], and habits and actions are embodied [16]. Although white walls are often associated with a clinical institutional setting [6, 13] optimum colour to enhance emotional well-being in primary healthcare is without definitive guidance, although some EBD colour recommendations are emerging for other healthcare settings.

An eight-phase study [12] sought to research best use of colour for long-term healthcare (LTHC). Five UK site audits were completed before conducting simulated and real world research. Audit included interior wall surround colour, textiles in situ, and orientation of building, room function, and light measurement. Analysis included Natural Colour System®© [17] (NCS®©) notations for pre-selected colour. Photoshop colour schemes were viewed during focus groups, and statistical analysis undertaken of hue, chromaticity and lightness, interview data and post occupancy evaluation. The study concluded with recommendations for LTHC, such as green hue is less popular, lower saturation and brightness resulting in pale, soft colours and a non-institutional atmosphere for older people is preferred.

For younger people, green was found to reduce stress for low screeners [13]. Screening refers to how individual personality traits process the environment and is related to health outcomes such as anxiety [13]. In this simulated study, with white as a control, 89 students reviewed photographs of orange or green orderly hospital rooms for a postoperative recovery scenario. Screening ability was measured prior to the experiment with assumptions that being asked to view the colour would negate screening effect. Orange was perceived to be more attractive than white based on a bipolar scale including words such as 'pleasant-unpleasant'. This study concluded that white is stressful for low screeners, and green reduces stress for low screeners.

In the UK, surveys, interviews, and focus groups were undertaken as part of pre- and post-test during a move to new purpose built GP premises, and included use of artwork on the walls. No discussion was made regarding colour selection, however, patients described new rooms as 'relaxing

and comforting', as opposed to previously, 'not very comforting' [5], thus supporting an improvement in well-being based on introducing a domestic style design but doesn't contribute to evidence regarding colour specifications. Similarly, recommendations for psychotherapy offices [18] analysis of responses from students and therapists who reviewed photos, and states the importance of softness and order contribute to quality of intervention. This importance is consistent across cultures, where chair comfort and colour are rated the two most important office attributes [19].

Comparably, colour specifications without analysis of ambient factor such as textiles, furnishings, artifacts, and needs of people is detrimental [20] according to an architectural approach which used mixed methods (MM) to create a supportive environment for older frail residential adults. A 2012 review [7] confirms potential of colour as part of EBD. However, with too few test retests and comparable studies, definitive guidelines for specialist GP services regarding which colour to use are not available. An ideal time to discuss which colour, according to a 2014 study that included public participation and surveys to study preferred décor, could be once other service needs have been addressed [21]. It is feasible therefore that colour and emotional well-being could be measured in the GP practice, using mixed methods such as focus groups and questionnaires.

Method

Mixed method

The purpose for this mixed-method study is complementarity and development, which encompass cross tracks analysis [22]. Figure 1 shows the method overview, illustrating a sequential parallel design.

Quantitative strand

Non-probability sampling occurred pre Phase 1. A member of the healthcare team approached participants during their appointment (n=not available) and people active in the Patient Participant Group (n=2) contacted. Patients responding to the promotional Poster (n=not available), were contacted, and allocated using birthdate and month to reduce potential for bias. The pre-questionnaire provided a convenient, purposive option to indicate interest in attending focus groups. A limitation is that bias can occur when collecting the secondary data set [23]. Eligibility included adults; willing and able to participate and give informed consent, anticipated to attend the same specified clinical room twice within the research timeframe. Excluded people; with complex or high clinical needs prioritised over participation, anxiety or discomfort caused by being asked to view a colour, complete a questionnaire or attend a group, or that language prohibits them from understanding the questionnaire.

Qualitative strand

Some participants were provided with pre focus group worksheet to support preparation (n=not available). Preparation of the research site and materials was undertaken. The room was audited, and walls and trim repainted using comparable NCS®© colours to negate potential effect from refurbishment. The room contained items associated with non-clinical consulting, such as desk, computer and printer, notice board, staff chair, paper documents and storage. Fixtures and fittings in a range of textiles included blue, grey and brown variations and pale lilac window blinds (Figure 2). In order to reduce bias resulting from a freshly decorated room, all four off-white walls were repainted similar to previous using NCS®© S 0502-Y prior to collecting pre questionnaires.

NCS®© has 1950 standardised notations. The researcher considered the literature alongside a visual process to select a manageable number of notations suitable for the focus groups. Colour design schemes for health care [24] include the provision of tonal detail, limiting the colour palette to create a calm rather than busy environment and harmonising the colour scheme with existing materials in situ. Examples of harmonious schemes include using single, adjacent, triad or opposing hues from the colour circle, with variations in saturation. A range of notations was selected to provide simple colour schemes and choices (Figure 3). The selected notations were hand painted onto A2 sample boards (Figure 4).
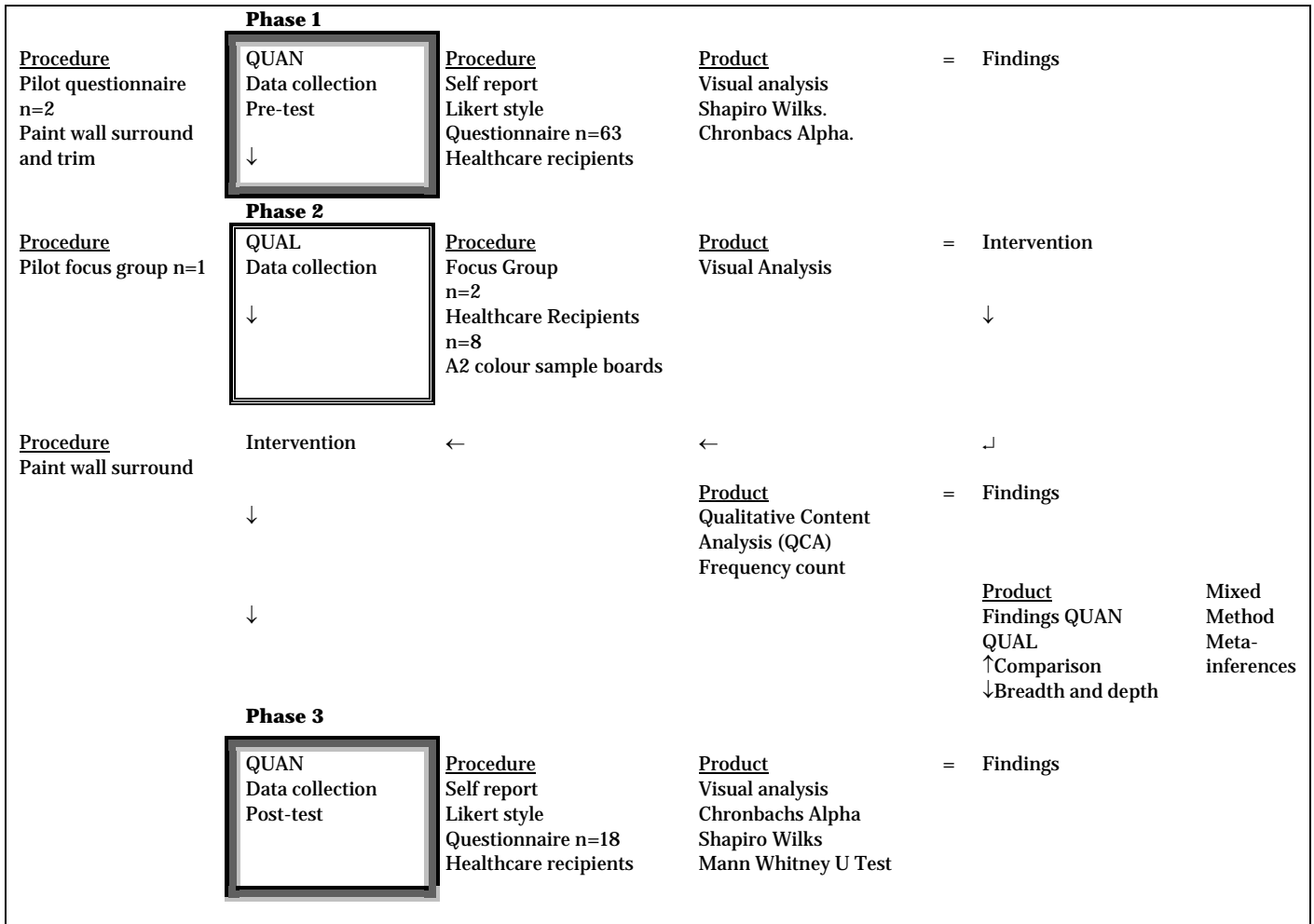
Phase 1

Procedure	QUAN	Procedure	Product	=	Findings
Pilot questionnaire n=2 Paint wall surround and trim	Data collection Pre-test ↓	Self report Likert style Questionnaire n=63 Healthcare recipients	Visual analysis Shapiro Wilks. Chronbacs Alpha.		

Phase 2

Procedure	QUAL	Procedure	Product	=	Intervention
Pilot focus group n=1	Data collection ↓	Focus Group n=2 Healthcare Recipients n=8 A2 colour sample boards	Visual Analysis		↓

Procedure	Intervention ←		←		↵
Paint wall surround	↓		Product Qualitative Content Analysis (QCA) Frequency count	=	Findings
	↓				Product Mixed Findings QUAN Method QUAL Meta-↑Comparison inferences ↓Breadth and depth

Phase 3

QUAN	Procedure	Product	=	Findings
Data collection Post-test	Self report Likert style Questionnaire n=18 Healthcare recipients	Visual analysis Chronbachs Alpha Shapiro Wilks Mann Whitney U Test		

Figure 1: Method overview, a sequential parallel design.

Figure 2: Consulting room following refurbishment, pre-test.
Part view for the client during a consultation (left) and the couch (right).

Figure 3 (left): Visual process of selecting notations in situ.

Figure 4 (right): Hand painted A2 sample boards.

Procedure

Quantitative strand

The researcher trained clinicians (n=4) in questionnaire administration. The seven item Likert style self-completion questionnaire was designed by the researcher after reviewing literature and advice sought from colour expert, staff at the site and piloted, with test retest with participants (n=2). This resulted in minor wording adjustment and incorporating colour samples on the focus group scoring sheet to address potential illiteracy.

Qualitative strand

Three semi-structured focus groups, one half hours duration, were facilitated by the researcher in the consulting room, 'Room X', who held the pre-painted sample boards in a generally constant position at 120° for approximately one minute per sample board. Feedback was requested by the researcher to enhance focus groups 2 and 3. As appropriate for real world research, the layout of the room (as shown in Figure 5) was adapted during each focus group in response to requirements to facilitate optimum vision, positive group dynamics, comfort, and discussion. Chairs were placed closer together, and a low table situated centrally for refreshments.
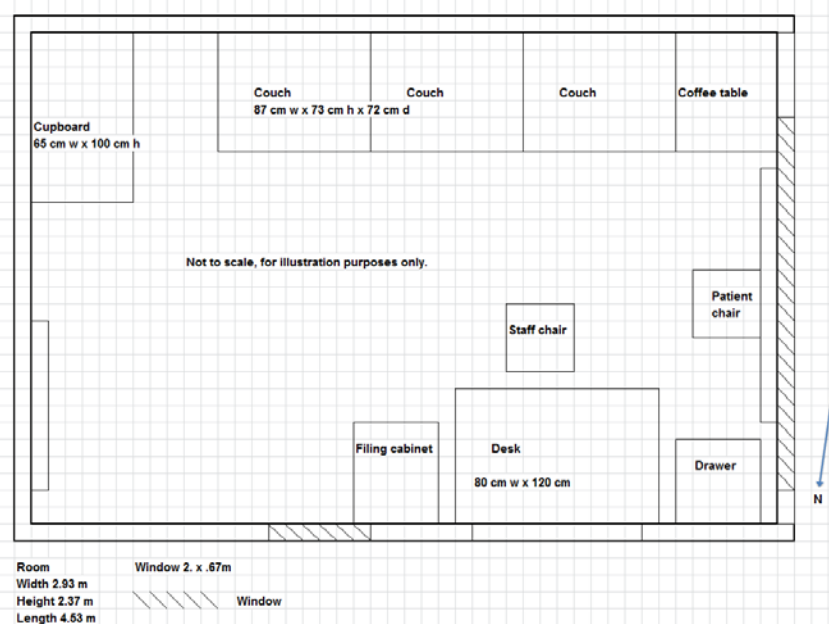

Figure 5: Floor plan, adapted slightly for each focus group.

Intervention

Pre Phase 3 application of wall covering. The NCS®© notations: S 0510 Y60R and S 0520 Y50R were selected (Figure 6).

S refers to Standard. Notation S 0510 Y60R are perceived as: 05=5% blackness (dark), 10=10% chromaticness (saturation of colour), 60% Red and 40% Yellow. The colour is perceived as pale peachy orange. A slightly more saturated pale orange, S 0520 Y50R, was selected for application to one wall which was a small area around the large window.

Figure 6: S 0510-Y60R (left) was applied to three walls and S 0520-Y50R (right) was applied around the window area.

Data analysis

Quantitative analysis

A description of the data was completed, followed by inferential analysis of relationships between Items using IBM Statistical Package for Social Sciences, Version 20 (SPSS v20). Overall well-being and well-being Items pre- post- difference was analysed to find normality, reliability, comparison and correlations between relationships, investigating colour, and lighting, weather, ethnicity, mood, age, gender and medical diagnosis. Probability adopts the standard of $p < 0.05$. Missing data was removed from individual computations.

Qualitative analysis

Manifest content [25] was read first to identify relevant and non-relevant material for qualitative content analysis (QCA). Data was segmented thematically. A deductive framework was drawn from the focus group questions and questionnaire items. Data appearing more than once was subsumed into a previous category and new categories generated for data not subsumed. Consistency was aided by decision rules. Scribe checked all transcripts, participants (n=4), member checked transcripts and emerging categories (n=2). To assess stability, the data was coded and compared at the early and later coding stages and a percentage of agreement calculated. Based on the percentage of agreement, face validity is considered reasonable for this study, however the category 'context' would require subcategories to validate additional analysis.

Mixed-method analysis

Convenience, purposive sampling between strands allows for comparison and relating findings [23].

i.   Items from Phase 1 questionnaire are used deductively within Phase 2 data analysis.

ii.   Some qualitative data was quantified, thus a frequency count was made of the questionnaire well-being items.

iii.   A simple reflection of data from Phase 2 developed the intervention required for sequential Phase 3 data collection.

iv.   Comments made on the questionnaire as part of the quantitative strand were compared to the coding frame.

Results

Quantitative analysis

Sixty three pre- and 18 post-test questionnaires were obtained. For brevity, descriptive and inferential statistics will present results from the 18 completed questionnaires pertaining to age and well-being. Participants were male and female, age range 27-76 years old.

Questionnaire demographic categories		number
Gender	Male	5
	Female	13
Colour deficient	Male	0
	Female	0
Age	Range	27-76
	Mean	41.28
	Standard deviation	12.95
Diagnosis	Depression and anxiety	6
	Depression or anxiety	4
	Neither depression or anxiety	6
	Missing	2
Ethnicity	Black/mixed	1
	White/black mixed	1
	White/British	13
	White/other European	3
Made a written comment		8
Requested information on outcomes		14

Table 1: Questionnaire demographics.

Visual analysis of mood appeared unrelated to brightness of weather or lighting. Statistical analysis of mood, or ethnicity wasn't undertaken due to small sample sizes. Internal reliability was tested using Cronbach's alpha. This was pre- .890 and post- .898 test, meeting requirements for combining items in a scale [26]. Normality test for smaller samples using Shapiro-Wilks found data is not normally distributed, thus non parametric tests were used.

Well-being Items

Mean and standard deviation for well-being Items were computed and visually indicated a more positive response than pre scores. Three outliers, indicating non-normality, were identified and noted to be female focus group participants' age range 42-60 years old.

Well-being Items	Pre-test		Post-test	
	Mean	Standard deviation	Mean	Standard deviation
Welcome/Unwelcome	3.11	1.13	3.83	1.20
Safe/Unsafe	4.11	1.18	4.28	0.89
Comfortable/Uncomfortable	4.00	1.41	4.22	1.11
Interested/Uninterested	2.55	1.20	3.00	1.23
Relaxed/Stressful	3.61	1.09	4.17	0.86
Happy/Unhappy	3.39	1.14	3.61	1.14
Calm/Energised	3.41	0.86	4.22	0.88

Note: Response scale reference – 5 = a lot welcome, 4 = a little welcome, 3 = neither, 2 = a little unwelcome, 1 = a lot unwelcome

Table 2: Mean and standard deviation of the seven well-being items.

Age

Statistical analysis of pre- post- difference scores using Spearman's Rho identified a small positive relationship between age and all well-being Items, and moderate relationship for safe and happy, and a movement towards energised from calm. This suggests that the older the participant, the more probability to feel overall well-being following intervention. See Figures 7-10 for scatterplot illustrating relationship of safe and happy to colour and well-being.
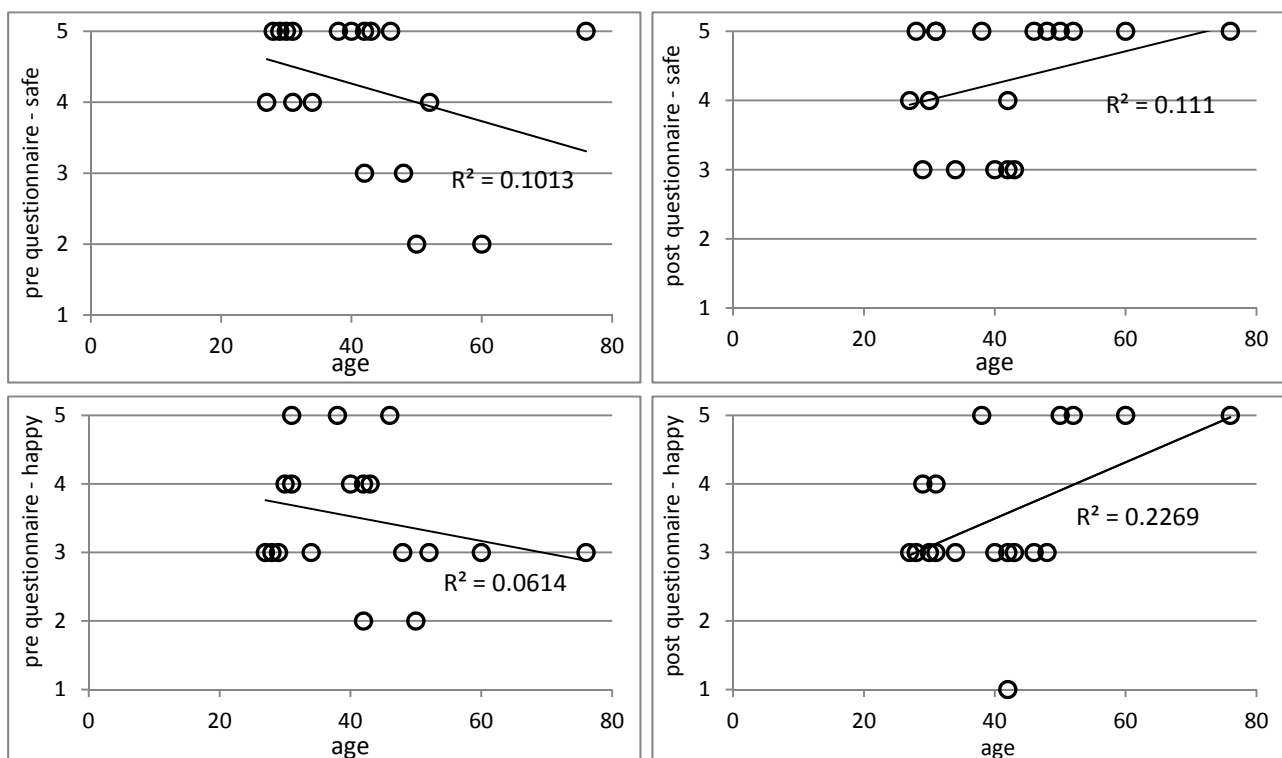

Figure 7 (top left): Negative relationship between age and safety, pre-test.
Figure 8 (top right): Positive relationship between age and safety, post-test.
Figure 9 (bottom left): Negative relationship between age and happy, pre-test.
Figure 10 (bottom right): Positive relationship between age and happy, post-test.

The results of the quantitative strand indicate overall well-being correlated positively with age following intervention. Further analysis of interaction between variables was not possible due to the small sample size.

Qualitative analysis

Three groups comprised eight participants, (f=7), age range 19 to 76 years old, mean of 42.50, standard deviation of 19.2, ethnicity: other/European (n=4), white/British (n=3) and white/Scottish (n=1). Nine categories emerged. A trend for warm, such as soft yellow or peach or a natural colour, rather than a clinical or inappropriate colour such as 'magnolia' or 'lime green' was identified. 'Natural' appeared to be a stronger indicator than perceived temperature affect for blue and green. For example, there was no preference for a cool blue, rather for a sky or sea blue. Blue and green were typically associated negatively with a clinical healthcare environment. A plain off-white room required attention to visual detail such as orderliness, artwork, and comfortable seating as an indicator that the room was a welcoming and comfortable place for participants, not wholly an office space for staff. Intentional colour design such as a combination of two contemporary harmonious notations helped visitors to feel thought about.

A frequency count for items as shown in Table 3 illustrated the importance of feeling welcome.

Item	Frequency count
Welcome and invited	29
Safe	3
Comfortable and at ease	24
Interested	12
Relaxed	14
Happy and cheerful	11
Calmly energised	17
Personal and thought about	1

Table 3: Frequency count of the well-being items.
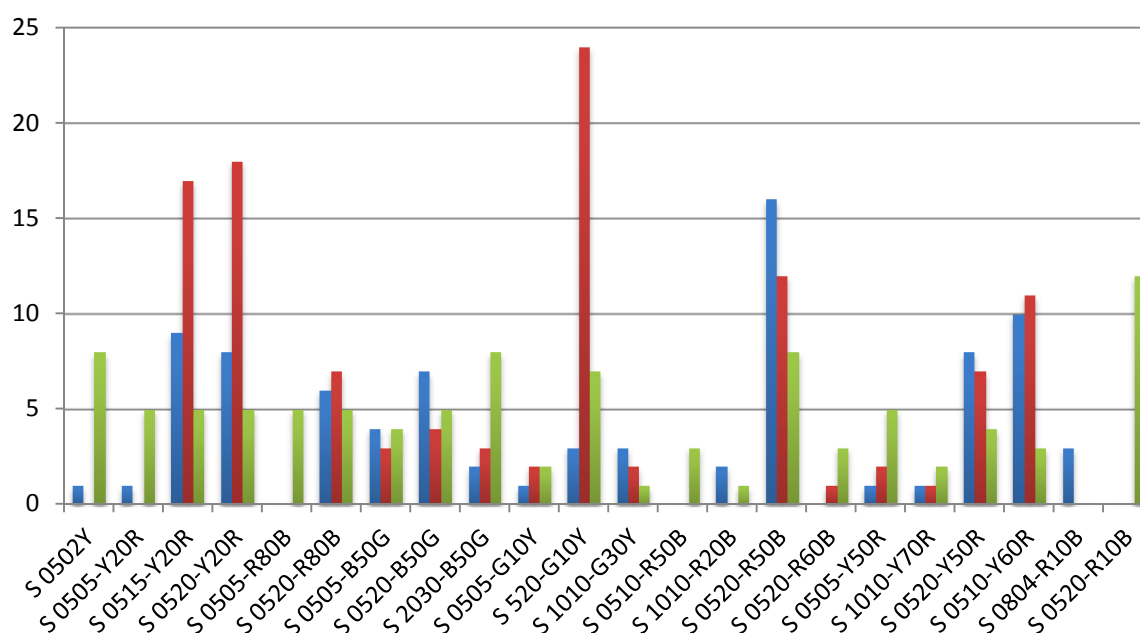

Figure 11: Frequency count in response to sample boards (blue: inconclusive; red: positive; green; negative).

A frequency count in response to sample boards, as shown in Figure 11 indicates that no one notation was selected by everyone. Comments in the inconclusive category revealed relevance of context. Temporal influence such as memory and associations connected with aesthetics and specific colour. The habits, activity, and expectations pertinent for different age, genders, and reasons for the appointment were part of the discussion, and demonstrated the complexity of colour selection.

Mixed-method analysis

Of the 63 Phase 1 participants, 30 stated interest in attending Phase 2 focus group discussions. Of the 18 Phase 3 participants, six attended a focus group, and two focus group participants did not complete post-questionnaires.

i.   Inductively, 'personal and thought about' emerged as a well-being concept from the focus group.

ii.   Quantitative data confirmed the need to feel welcome and comfortable and introduces the concept 'personal and thought about', exploring further depth of meaning.

iii.   A reflection on the raw data from Phase 2 indicated a preference for 'warm' e.g. yellow or orange. An unusual hue e.g. bright red or lime green was considered inappropriate. Blue and green were potentially acceptable, but linked to negative associations of the healthcare environment. Thus, two notations, S 0510 Y60R and S 0520 Y50R were selected by the researcher and applied to the interior wall.

Results for the experimental hypothesis suggest colour might enhance a sense of well-being in relation to age. Age was not referred to within the questionnaire comments; however, the finding that age correlates negatively with off-white and positively with a more saturated hue in the healthcare environment will be explored further within discussion.

Discussion

Mixed method analysis suggest that a combination of two light orange colours, S 0510 Y60R and S 0520 Y50R enhances a sense of emotional well-being more than off-white, within context, such as comfortable seating, visual detail and a personalised space. Further, a relationship between colour, increased well-being, and age is indicated.

A plausible reason for age related improvement could be that because eyesight deteriorates with age, colour is more difficult to see, or that emotional responses can change with age [27] therefore a more saturated hue is visible and thus stimulates opinion. However, the mean age of questionnaire participants was 41.28 thus, visual deficit due to depression [28] maybe also relevant. Frequency of attendance to the surgery is not available, however this sample, by definition, could be regular attenders. Frequent association with the experience of illness, pain, or depression while in a traditional off-white clinical setting could create a learned association. 'Ecological variance' whereby people like colours associated with objects they like, and dislike colours associated with objects they don't like [29] is worthy of consideration; the application of orange nuances departs from possible learned negative association and consequently supports well-being connotations. Similarly, although green, perceived as both restful, and also too clinical, has positive nature connotations [30], yet over use in the clinical environment [24] could have a negative effect on well-being. In addition, as a cool

colour, green is perceived as receding, whereas orange, a warm colour, is perceived as advancing, possibly creating a more cosy, and thus safe, atmosphere.

The embodied influence of unpleasant past associations to colour whilst simultaneously experiencing a multi-sensory environment can be likened to a 2013 study [16] which found that discord between lived and expected sensations can feel uncomfortable and dissatisfying during occupations. This complex interaction with colour aesthetics could suggest why participants do not want an inappropriate colour.

Although a small sample size cannot be generalised, the mixed method findings are compatible with trends moving away from traditional plain, off-white, clinical settings, towards a comfortable and non-institutional 'modern' atmosphere [21], thus practitioners can consider if recommendations can be applied to specific practice contexts. Limitations of the study acknowledge constraints of a novice researcher in a real world context, and the broader implications of lighting or colour for way finding has not been audited. However, the strength of the study is that some results do correspond to emerging trends.

Recommendations to promote inclusive practice are to attend to the individual design and character of a non-clinical consulting room as part of the occupational transaction. Use of a slightly more saturated yellow or orange hue is a simple option. Avoid indiscriminate use of off-white to create a comforting and inviting environment without attention to seating, visual detail, and display of appropriate artwork on plain walls. Audit and longitudinal study will ensure context, lifespan, and that longer-term implications are addressed. For future research, increased sample size is recommended to increase the robustness of the work. In conclusion, thoughtfully applied colour could enhance a sense of well-being in specialist primary care services and a cumulative effect is suggested for age.

Acknowledgement

References

1. Cutchin M (2004), Using Deweyan philosophy to rename and reframe adaptation-to-environment, *The American Journal of Occupational Therapy*, **58**, 303-312.

2. Boag-Munroe G and Evangelou M (2010), From hard to reach to how to reach: A systematic review of the literature on hard-to-reach families, *Research Papers in Education*, **27** (2), 209-239.

3. Inclusion Health (2014), Promising Practice, [https://www.gov.uk/government/uploads/.../Promising_Practice.pdf – last accessed November 2014].

4. Centre for Healthcare Design (2015), Moving health forward, [https://www.healthdesign.org/chd – last accessed March 2015].

5. Rice G, Ingram J and Mizan J (2008), Enhancing a primary care environment: a case study of effects on patients and staff in a single general practice. *British Journal of General Practice*, e1-8.

6. Tofle RB, Schwarz B, Yoon S and Max-Royale A (2004), *Color in Healthcare Environments – A Research Report*, The Coalition for Health Environment Research.

7. Bosch S, Edelstein E, Cama R and Malkin J (2012), *The Application of Color in Healthcare Settings*, The Center for Health Design, 1-78.

8. Conway M (2008), *Occupational Therapy and Inclusive Design*. West Sussex: Blackwell Publishing.

9. Coote A (2015), *People, Planet, Power: Towards a New Settlement*, London: New Economics Foundation.

10. Michaelson J, Abdallah S, Steuer N, Thompson S and Marks N (2009), *National Accounts of Well-being: Bringing Real Wealth onto the Balance Sheet*, London: The New Economics Foundation.

11. Payne S, Potter R and Cain R (2014), Linking the physical design of health-care environments to well-being indicators, in *Wellbeing: A complete Reference Guide, Volume II, Wellbeing and the Environment*, Cooper R, Burton E and Cooper CL (eds.), 391-418, John Wiley & Sons.

12. Dalke H and Matheson M (2007), *Colour Design Schemes for Long-term Healthcare Environments*, London: Arts and Humanities Research Council.

13. Dijkstra K, Pieterse ME and Pruyn AT (2008), Individual differences in reactions towards color in simulated healthcare environments: The role of stimulus screening ability, *Journal of Environmental Psychology*, **28**, 268-277.

14. Dickie V, Cutchin MP and Humphrey R (2006), Occupational as transactional experience: a critique of individualism in occupational science, *Journal of Occupational Science*, **13** (1), 89-93.

15. Cutchin MP (2013), The art and science of occupation: nature, inquiry and the aesthetics of living, *Journal of Occupational Science*, **20** (4), 286-297.

16. Bailliard AL (2013), The embodied sensory experiences of Latino migrants to small town, North Carolina, *Journal of Occupational Science*, **20** (2), 120-130.

17. Natural Colour System (2012), [http://www.ncscolour.co.uk – last accessed November 2014].

18. Devlin AS and Nasar JL (2012), Impressions of psychotherapists' offices: Do therapists and clients agree?, *Professional Psychology: Research & Practice*, **43**, 118-122.

19. Devlin AS, Nasar JL and Cubkcu E (2014), Students' impressions of psychotherapists' offices: cross-cultural comparisons, *Environment and Behavior*, **46** (8), 946–971.

20. Andersson JE (2011), "Touching up" communal Space of a residential home set-ting: A comparative study of tools for assessing changes in the interior architectural space, *Journal of Housing for the Elderly*, **25** (2), 175-216.

21. Mackrill PJ, Cain R, Strelitz J and Gate L (2014), Developing interior design briefs for health-care and well-being centres through public participation, *Architectural Engineering and Design Management*, **11** (4), 264-279.

22. Greene J (2007), *Mixed Methods in Social Enquiry*, John Wiley & Sons.

23. Creswell JW and Plano Clark VL (2011), *Designing and Conducting Mixed Methods Research* (Second Edition). Sage Publications Inc.

24. Dalke H, Littlefair PJ, Loe LD and Camgoz N (2004), *Lighting and Colour for Hospital Design* (NHS Estates Funded Research Project Report), London South Bank University.

25. Schreier M (2013), *Qualitative Content Analysis in Practice*, Sage Publications Ltd.

26. Garson DG (2012), *Testing Statistical Assumptions*, Statistical Associates Publishing.

27. Ou L, Luo MR, Sun P-L, Hu N-C and Chen H-S (2012), Age effects on colour emotion, preference, and harmony, *Color Research and Application*, **37** (2), 92-105.

28. Buble E, Kern K, Ebert D, Bach M and Tebartz van Elst L (2010), Seeing gray when feeling blue? Depression can be measured in the eye of the diseased, *Biological Psychiatry*, **68** (2), 205-208.

29. Palmer SE and Schloss KB (2011), Ecological valence and human colour preference, in New Directions on Colour Studies, Biggam CP, Hough C, Kay CJ and Simmons DR (eds.), 361-376, Amsterdam: John Benjamins.

30. Ulrich R and Zimring C (2004), *The Role of the Physical Environment in the Hospital of the 21st Century: A Once in a Lifetime Opportunity* (The Centre for Health Design's Designing the 21st Century Hospital Project Report), Robert Wood Johnson Foundation.