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The use of Questionnaires in Colour Research in Real Life Settings: In search of validity and methodological pitfalls

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Abstract

This research discusses the validity of applying questionnaires in colour research in real life settings. In the literature the conclusions concerning the influences of colours on human performance and well-being are often conflicting. This can be caused by the artificial setting of the test process. Applying questionnaires could also be a cause. To avoid the disadvantages of an artificial setting, a colour research process was organized in a real life setting. In order to get a better understanding of the validity and possible pitfalls in using questionnaires, the responses to the questionnaires were analysed. During colour research looking for the colour influences on perceived productivity, social cohesion and well-being during meetings, responses to questionnaires were compared with findings from observations of behaviour and additional interviews with the respondents. Discrepancies were found indicating weaknesses of applying questionnaires in colour research. The findings suggest that questionnaires alone are not a fully appropriate tool to establish the colour influences. Triangulation by observations, additional interviews and sampling techniques can improve the validity of measuring the influence of different colours.

Keywords: questionnaires, observations, methodology, social psychology, colour influences

Introduction

Conflicting results in colour research

Much colour research analysing the influences of colour on human beings is being conducted in an artificial setting by employing students performing artificial tasks, using different test materials and measuring effects by using questionnaires (Elliot, 2007 & 2008; Bellizi, 1983; Maier, 2008; Stone, 2001). The results are often conflicting (Elliot, 2007; Tofle, 2004). There are several possible reasons for these conflicting results. Firstly, lab situations are a reduction of the complex physical and social contexts of real life situations (Vonk, 2003). The use of lab facilities (such as in Elliot, 2007; Moller, 2009; Roberts, 2010; Berlin, 1998; Bellizi, 1983), is often criticized (Tofle, 2004), because the effects of colour are highly dependent on its context (Crowley, 1993; Elliot, 2007, Maier, 2008; Conway, 2009; Beach et al, 1988). The effects of colours are for instance dependent on physical context variables such as daylight, space

dimensions and textures, and of social context variables i.e. social interactions are different in a natural environment compared with a lab situation. Secondly, most colour research is conducted with subjects who are students (such as in Elliot, 2007 & 2008, Zentall, 2000; Read, 1999; Roberts, 2010; Maier, 2008; Metha & Zhu, 2009, Wilson, 1966, Claessen, 1995; Moller, 2009). Colour testing with students results in selection bias (Sears, 1986, in Vonk, 2003) as students are not representative for the overall population. The intrinsic motivation of students often differs from subjects in a real life situation. For example employees are motivated by social and organizational dependencies, whereas students are more interested in having fun (Bellizi, 1983) or in getting course credits (Metha & Zhu, 2009; Elliot, 2007). Thirdly, it is difficult to compare artificial tasks with real life task performances, where social interdependencies and organizational responsibilities are involved. Fourthly, in the lab settings different coloured test materials are used such as virtual colouring with screens (Metha & Zhu, 2009; Kay & Epps, 2004; Dijkstra, 2009); clothing (Roberts, 2010), slides (Bellizi, 1983), colour photographs (Sivik, 1973), colour samples like pegs (Claessen, 1995) and colour pictures (Wilson, 1966). Materials with different characteristics like texture influence colour research results. An example is the study of Sivik (1974) on colour effects of two types of buildings. In a test with colour chips people didn't like shades. However, in slide images people liked various shades of yellow-beige. Next to these four causes of the conflicting results, using questionnaires could also be a cause. Often questionnaires are used for testing the colour influences on diverse cognitive, emotional and affective aspects (Bellizi, 1983; Coad, 2008; Yoto, 2007; Lichtenfeld, 2009; Stone, 2001). Focussing on different topics such as anxiety and pleasure (Verhoeven, 2008), stress, attractiveness and professional quality (Dijkstra, 2009), and mood, arousal, vigilance and eagerness (Elliot, 2007), makes comparison of research findings difficult.

Next to these differences, the validity of questionnaires might be questioned for instance regarding the correctness of the answers of participants. Answers are mixtures of individual opinions influenced by psychological phenomena and contexts (Vonk, 2003; Ekman, 2008). The question is whether the responses to questionnaires are sufficiently valid in order to be able to draw sound conclusions concerning the influence of colour. Research concerning the application of questionnaires as an appropriate means to analyse the truth, indicate that questionnaire findings may have limited validity, e.g. due to a lack of interest of respondents, the fact that respondents not always tell the truth and the unwillingness of respondents to admit certain attitudes or behaviour (Foddy, 1993).
In summary, the main drawbacks of current studies on the influence of colour is, that most studies are conducted in an artificial setting using questionnaires as a main method to measure effects.

Testing the validity of completing questionnaires in real life settings

From a methodological point of view, an interesting question is whether the influence of colour as a complex phenomenon and as an integral part of the environment, influencing all human senses, can be analysed in an artificial environment with questionnaires. Because people experience colour in real life,

the optimal approach to test the influence of colour is testing in a real life setting. However, in real life situations there are other factors that may influence the process of completing questionnaires and the results. Differences in outcomes may be caused by context factors related to the test environments, the test situations and the test processes on the one hand and human characteristics on the other hand. A human characteristic could be a difference in sensitivity (e.g.Mehrabian & Russell, 1974) or can be related to psychological phenomena, like unconsciousness of the environment that effect people in general. These three types of impact factors can be identified as: contextual factors, personal characteristics and psychological phenomena.

Contextual factors: Mental processes can only be understood within the context of the interaction between human beings and their situation (Damasio, 2006). Experiencing the test environment is determined by the physical environment subjects are accustomed to. When people work for instance in a white coloured work environment, every new colour will be conceived as irregular and approached rather critically. Also the organizational and social context with their organizational and social norms, might affect the process of completing questionnaires. Tasks, responsibilities and attitudes influence the way employees observe and perceive the physical environment (Küller, 1973). For instance, when an employee with serious responsibilities is involved in a meeting process, his attention is primarily directed to the meeting's topics and not to the environmental aspects (Applyard, 1973). Another serious contextual factor is the test process. Involvement in a specific test process is a special event, which probably might activate attention and enlarges personal status and feelings of importance. As a consequence the test process itself can affect the attitude of the subject and the existing social context.

Personal characteristics: Personal characteristics determine the way subjects experience the physical environmental and the social and organizational context and how they express these experiences in completing questionnaires. In real life settings differences in environmental sensitivities may result in different experiences of the environment (Mehrabian & Russell, 1974).

Psychological phenomena: Psychological phenomena influence the process of completing questionnaires. People are for instance unconscious of their physical environment (Dijksterhuis, 2007; Schneider, 1987), don't tell everything in questionnaires (Vonk, 2003) and are unconscious of their own cognitions about the environment (Vonk, 2003). In human behaviour 'cognitive dissonance' may play a role: people don't like to have cognitions which are conflicting with each other and try to bring their cognitions into harmony (Festinger, 1957). The phenomenon of social desirability bias might have an impact as well. Some respondents' answers to questions may be related to their perception of the social desirability of their answers (Bryman, 2012, p. 228).

The factors and phenomena described above are clearly mentioned in the environmental and psychological literature. However in the literature on the influence of colour, no reflections were found that these factors and phenomena influence the process of completing questionnaires and as such might influence the results and conclusions. The question can be asked if reported results based on completed questionnaires can be conceived as clear and true facts which directly can be connected to the research topic: the impact of colour.

Considering the critical remarks on using questionnaires, in the present study the influence of different coloured meeting rooms is tested in an existing office and not in a laboratory, with governmental employees and not with students, conducting usual tasks – regular team meetings - and no artificial tasks, and with real coloured walls in a real life setting instead of artificial materials in a lab setting. In order to test the validity of questionnaires to collect opinions about perceived productivity, social cohesion and wellbeing, the meeting process and the process of applying questionnaires was observed and monitored and analysed so that the afore mentioned phenomena could be discerned. The present paper discusses whether the findings from questionnaires were consistent with observed behaviour, in order to answer the question: are questionnaires an appropriate measurement to collect data which can be used to draw clear conclusions concerning the influences of colour in a real life situation? Due to the complexity of the surrounding environment and more specifically the phenomenon colour, the complexity of the human psyche and psychological processes related to the transformation processes of affect into cognitive verbalization of perceptions, the hypothesis was that questionnaires alone don't give a valid understanding of the influences of colour.

Method

Test setting

The influence of colour was tested in a real working situation, with two coloured meeting rooms (a red and a blue one) and a standard reference room in a government building in Rijswijk, the Netherlands. Seven regular meeting teams with totally 52 members were observed, each during seven formal routine meeting sessions (in total 49 test sessions). Standard questionnaires were systematically composed based on both former colour research and research on productivity. The government employees completed the questionnaires with statements on a seven points scale (ranging from strongly disagreeing to strongly agreeing) concerning the meeting productivity, social cohesion and well-being, appraisal of room aspects (including colour) and preferred rooms. The results of this test are published in a separate paper (Bakker et al., 2013) and not presented here because this paper focuses on the validity of using questionnaires in a real life setting. In the present paper additional analyses are presented concerning relationships between room appraisal and colour appraisal and the relative importance that participants attach to interior elements.

Test process: data collection

For collecting data during the meeting sessions, four questionnaires were used. One questionnaire was administered directly before the meeting (questionnaire Q1), one directly after the meeting (Q2), both in the meeting room and a third questionnaire two to three days after the meeting by E-mail (Q3). Two to three weeks after the last meeting session, a fourth end-questionnaire was sent out by E-mail (Q4) asking for personal opinions related to the three meeting rooms (the two coloured test rooms and the standard reference room), such as room preferences and the relative importance of interior elements (among other things colour, indoor climate and comfortable chairs). Three first three questionnaires Q1, Q2, Q3 were completed by the participants seven times (once per meeting session). The end-questionnaire Q4 was completed once.

Test process: using questionnaires

To get a clear insight into the subjects' considerations while completing questionnaires on the impact of colour during the test process, data were systematically collected according to the next table (see Table I).

Table I: contextual, personal and psychological factors and phenomena which may appear during colour research using questionnaires

factors and phenomena	types	examples
contextual	physical	being accustomed to the physical environment
	organizational	norms and culture
	social	social desirability
	test related	personal interest
personal	personal characteristics	sensitive to the environment
psychological	cognitive dissonance	reducing differences between two cognitions such as avoiding discrepancies between made remarks and new opinions
	unconsciousness of the environment	not knowing the colour of the wall
	unconsciousness of the own cognitions	not realising the relation between cognitions and stimuli, such as positive feelings of space not realising what's the cause
	don't tell everything	not telling about personal dissatisfaction

Because of the particular interest in methodological validity and possible pitfalls, the full research process was watched closely to be able to establish the validity of the answers mentioned in the questionnaires. Therefore during the 49 test sessions the researcher was present. In a research process document the researcher listed subjects' positions at the table and their behaviour such as communication patterns, duration and number of questions subjects asked during the meeting, time for

giving information, laughing and posture. Comments and remarks of subjects and incidents before, during and after the meetings were recorded in a logbook. Directly after the meeting these data was compared with the data in the questionnaires Q1, Q2 and Q3. Discrepancies between the observed behaviour and statements of the participants during the meeting session and their responses to these questionnaires were captured in the logbook. In four cases showing discrepancies between the observed behaviour and their answers in the questionnaire that were difficult to explain, subjects were personally interviewed regarding the background of their responses. These interviews were conducted one or two days after the meeting session at their private office. Subjects were told that the research was focused on the influence of colours, but that also the processes such as forming opinions constituted a serious part of it. In summary, three types of documents were used during the test process: questionnaires, a research process document per meeting session and a logbook. As such, the possibility was created to discern any discrepancies between responses to the questionnaires Q1, Q2 and Q3, observations of actual behaviour and findings from additional interviews, which might be caused by the psychological factors and phenomena mentioned in Table 1.

Results

The research findings pointed to ambivalence about the impact of colour that was intended to measure. After analysing the questionnaires Q1, Q2 and Q3, research process documents and logbooks, thirteen discrepancies were recorded between subject's responses to the questionnaires and observed behaviour (see cases below) and/or the interview results, showing ambiguous relationships. Various cases represent discrepancies that refer to more than one person or to a whole team.

Case 1: Light-dark contrast with the previous environment

A meeting team had to wait a while in the sunny corridor before the meeting started. The team members entering the red test room had a discussion about the darkness of the room. They were unanimously convinced of the darkness of the red coloured room. However, the discussion did not have any influence on the mentioned scores in the questionnaires Q1, Q2 and Q3, neither on the rating of the room, the wall colour or the light. The fact that only this time the darkness of red room was discussed was caused by contextual factors: a short period in the sunny corridor caused an enlarged experience of darkness in the room. A possible explanation for not observing any effect in the responses to the questionnaires is that subjects are not aware of the connection between cognition (it is dark) and stimulus (the darkness) and that they pay no further attention to the environment because they were primarily focused on the meeting.

Case 2: Discrepancies in appraisal of the furniture

Many subjects spontaneously uttered positive remarks about the round shape of the table in the coloured rooms. According to them this shape stimulated human movement and created a pretty space. However,

the scores for this item in the end questionnaire Q4 were remarkably low. A possible explanation for the enthusiasm about the shape and the low rating in the questionnaire Q4 is that subjects are not actively focussed on elements of the physical environment and don't remember relations between cognitions and stimuli.

Case 3: Dissatisfaction with the meeting topic

Directly after one of the meetings subject A told that he was not satisfied about the approach of the meeting topic. Nevertheless in questionnaire Q2 and Q3, the scores regarding satisfaction about the meeting, the meeting process, results and productivity, were all positive. When asked about his answers, he admitted he gave high scores although he was not satisfied. Because he could not change the situation in the complex government organization, he opted for the scores he thought as being generally accepted in connection with his function, job responsibility and organization culture. He chose the scores he thought other people expected him to make that did not necessarily correspond with his personal opinion. The effect is related to several factors and phenomena: impact of the organizational culture and generally accepted norms, social desirability and the phenomenon that people don't tell everything.

Case 4: Irritation about unclear decisions during the meeting

Subject B several times asked the chairman to make more clear decisions, however no decision was made. Surprisingly subject B completed both questionnaires Q2 and Q3, with positive scores regarding the meeting results, meeting process and productivity. In an interview later on, subject B told that he was not satisfied but he could not change either the person or the situation. Low scores would not change this situation, so he decided to choose what he called "normal' scores. These scores were not a valid representation of his personal opinion but were influenced by organizational culture, generally accepted norms, social desirability and the phenomenon that people don't tell everything.

Case 5: Dissatisfaction with the team process and the results

After a meeting subject C told that he was not satisfied about the team process, the meeting and the results and more specific the input of his colleagues. Nevertheless the scores in questionnaires Q2 and Q3, were positive. In an interview with him later on, he told that his opinion did not matter at all and that he could not change the quality of the organizational process. He filled out high scores corresponding to his perceived job context and job responsibility. His responses can also be conceived as a result of organizational culture, generally accepted norms, social desirability and as such did not show his personal opinions.

Case 6: Interruptions

During a meeting subject D could not accomplish his own presentation because one of the team members took over. An analysis of the answers of subject D did not show any differences with his scores

in other meetings on the items 'I felt respected by the others' and 'They listened to me well'. No clear correlation exists between the incident during this particular meeting and the scores filled out in the questionnaires Q2 and Q3. Possible explanations are that he was used to being treated this way in the organization and the person who interrupted him or personal characteristics such as being a shy.

Case 7: Getting compliments from colleagues

In one meeting a substitute chairman (subject E) was asked to chair the meeting, because the regular chairman could not be present. At the end of the meeting one of the members told him that he was so happy because now he had felt someone was really listening to him and this had never happened before. The other team members agreed. However, the substitute chairman, who is a regular team member, filled out neutral scores in questionnaire Q2 and Q3, on the item ''I felt respected by the others'. In comparison to his scores in the questionnaires Q2 and Q3, regarding all other meetings, no difference was found, although this time he got many compliments. Probably subject E, being the chairman only once, mainly paid attention to the process as his responsibility. Another cause could be a personal characteristic (for instance being modest) or that subject E is unconscious of his own cognitions.

Case 8: Negative opinions versus positive scores

After a meeting in the blue room, subject F told that he was fond of the colour blue but he did not like the light. In contrast with this opinion, both scores in questionnaire Q2 and Q3, regarding light intensity and light colour were positive and did not differ from the scores in the other rooms. In an interview afterwards, subject F told he was satisfied about the meeting so he also mentioned satisfaction concerning the environment, although on a conscious level he was not content with this environment. His score is primarily based on his focus on the meeting and has nothing to do with the environmental conditions.

Case 9: Lack of interest: copying of responses

It turned out that some subjects did not complete all questionnaires Q1, Q2 and Q3 quite seriously. For instance, subject G copied his scores in questionnaire Q1 into questionnaire Q2. He got critical comments from his team members and his data was not used in the analysis. This example is related to his attitude to the research: subject G is not seriously committed to the research, or there is no personal interest.

Case 10: Responding (too) quickly

Subject H completed the questionnaires Q1, Q2 and Q3 rather quickly and after a check by the researcher it appeared that during the complete test process subject H used almost the same scores. It is questionable whether these answers really reflect his opinion or are more or less standardised because he was not seriously committed to the research, or there is no personal interest.

Case 11: Apologies for not having any colour preference

Subject I told the researcher that he was very sorry that he had no colour preference and that he mostly liked the reference room. The reason for apologizing could be that he felt affection for the researcher and/or assumed that the researcher expected him to have a colour preference or that he thought the researcher tried to find evidence for colour preferences. In the additional interview subject I told that he was convinced the researcher had a colour preference and expected him to have one as well. This looks like an example of the so-called interviewer effect, trying to please the interviewer, in this test the researcher. In many types of researches, the interviewer effect seems to have influenced the findings (Davis, 2010; Dykema, 2012; Johnson, 1994; Huddy, 1997).

Case 12: Mentioning colour perception

While completing the questionnaires Q1, Q2 and Q3 during the meetings, at least 30 % of the subjects looked up and around. May be these subjects recorded their individual colour perceptions and not their actual experiences and actual feelings. People may be not sensitive for their environment, unconscious of the environment or unconscious of their own cognitions.

Case 13: Impact of the chairman

For the first time entering the test room (in this case the red room), one chairman called out loudly ‘What an awful colour’. Consequently, he gave the red wall a low score and the blue wall a high score. Maybe his scores were influenced by cognitive dissonance reduction: it is possible that during the meeting the chairman realized that the colour red was not as bad as he at first thought. However because he was aware of the fact that the other team members had heard his remarks, he may have felt forced to mention that red was awful. Although this possibility exists, it cannot be proven with any certainty. Furthermore the remark of the chairman may have influenced the opinions of the other team members as well and as such made employees being inclined to give the same ‘socially desirable’ answers.

These cases can be related to the contextual, personal and psychological factors and phenomena that were discussed in the introduction (see table II).

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Table II: contextual, personal and psychological factors and phenomena which may have influenced the responses to the questionnaires

factors and phenomena	types	observed factors and phenomena	cases 1	2	3	4	5	6	7	8	9	10	11	12	13
contextual	physical	being accustomed to the physical environment	■	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
	organizational	norms and culture		■	■	■	■	■							
		attention to performances	■						■	■					
	social	social desirability			■	■	■								
	test related	attitude	▒	▒	▒	▒	▒	▒	▒	▒	■	■	▒	▒	▒
		affection to the interviewer											■		
		personal interest	▒	▒	▒	▒	▒	▒	▒	▒	■	■	▒	▒	▒
personal	personal characteristics	psychological factors						■	■						
		sensitive to the environment												■	
psychological	cognitive dissonance	reducing differences between two cognitions such as avoiding discrepancies between made remarks and new opinions													■
	unconsciousness of the environment	not knowing the color of the wall												■	
	unconsciousness of the own cognitions	not realising the relation between cognitions and stimuli, such as positive feelings of space not realising what's the cause	■	■					■					■	
	don't tell everything	not telling about personal dissatisfaction			■	■	■								

■ influencing factors and phenomena described in the cases

▒ factors influencing all cases

Per case the specific contextual, personal and psychological factors and phenomena are mentioned (in black) which may be a cause why answers in the questionnaire Q1, Q2 and Q3 are not in accordance with subjects' behaviour and/or interview results. Three aspects - in grey - play a role in all cases. Firstly, the physical environment the subjects are accustomed to determines how people judge their new environment (Vonk, 2003). Next, two test related issues always play a role: the attitude of the subject (whether the subject is serious, interested or involved) and personal interest (do subjects attach any importance to the research).

Time of responding

The correlation between the appraisal of the meeting room and the appraisal of the interior elements directly after the meeting was highest for wall colour and lowest for temperature and air quality (see table III below). Directly involved in the research process and knowing the research topic, the subjects related their appraisal above all to wall colour, and least at the aspects of the inner climate such as temperature and air quality.

Table III: Inter Item Correlation Matrix. Appraisal of the meeting room and wall colour showed highest correlations

Interior elements	Correlation between appraisal of the meeting room and appraisal of interior elements directly after the meeting
Top desk table	0,551
Wall colour	0,789
Light Intensity	0,569
Temperature	0,385
Air quality	0,402
Light colour	0,720

However, asking subjects after all test meeting sessions about the relative importance of twelve different interior aspects (Q4), subjects assigned a low score to wall colour (see table IV) and the highest scores to temperature and air quality.

In the government building the employees often complained about the temperature and the air quality in the meeting rooms. However, the appraisal of the three rooms showed a more positive and different pattern. This indicates that the relative importance the subjects attach to temperature and air quality is rather low at the moment of completing the questionnaire, and has no influence on the appraisal of the room. Valuing the room is based on valuing elements or parts of it. Although elements that are not mentioned in the questionnaire can have a substantial relative effect, they show no correlation with the appraisal of the three meeting rooms, while these elements are exactly the same for the three test rooms. High correlations with the test aspects colour of the light and colour of the wall had the highest scores, indicating that the appraisal of the room is influenced by these test aspects and that subjects attach importance to these aspects.

Table IV: Relative positions subjects assigned to interior elements

order	men	women	total
1st	air quality	air quality	air quality
2nd	temperature	temperature	temperature
3rd	chairs	daylight	daylight
4th	light intensity	light intensity	light intensity/chairs
5th	daylight	light color/chairs	light intensity/chairs
6th	acoustics	light color/chairs	acoustics
7th	light color	acoustics	light color
8th	shape table	wall color	shape table
9th	color table top	shape table	wall color
10th	wall color	plants	color table top
11th	plants	art	plants
12th	art	color table top	art

Discussion

Analysing the research process carefully, evidence is found for confirmation of the hypothesis that questionnaires alone don't give a valid understanding of the influences of colour. Causes can be observed due to the complexity of the surrounding environment, the complex phenomenon colour itself and the complexity of the human psyche with psychological processes related to the transformation process of affect into cognitive verbalization of perceptions. The next findings emerged from the research.

People and colour preference

Most subjects did not show any colour preference and had the opinion that colour was not important at all. When at the end of the test process all subjects were asked to mention their colour preferences in the end questionnaire Q4, 63 % of the male subjects and 61 % of the female subjects admitted they had no favourite wall colour. When asked about the relative importance of twelve components of the environment, air quality and temperature were ranked at the first and second position. These data are comparable with the work environment factors analysed by Dul (2007). Male subjects ranked wall colours at the tenth position and female subjects at the eighth. So on a conscious level most people think wall colours are not very important for their productivity, well being and social cohesion in a meeting.

Time of responding: influence of the test process

At the moments that the subjects were present in the test environment and more directly involved in the research process, the responses to the questionnaires showed a high correlation between the appraisal of the room and the appraisal of the wall colour and a low correlation with the appraisal of the inner climate. On the contrary, two to three weeks after all test meeting sessions, when subjects had more distance to the research process, wall colour did not play an important role in valuing the room (see table

IV) and temperature and air quality got highest scores (Q4). Apparently, the process setting influences the results. When participants completed the questionnaires Q1, Q2 and Q3 they were in the test room with the presence of the researcher, that both accentuated the colour issue of the research. Completing the end questionnaire Q4 happened in their own room at a distance from the test rooms without the presence of the researcher. In this situation colour as research topic was less accentuated or partly forgotten. Moreover, in the existing building some problems existed on the inner climate. When completing Q1, Q2 and Q3 specific attention was paid to the research topic and not to the regular inner climate problems, while at the time of completing Q4 the regular office situation with the inner climate problems got more attention.

Impact of a close contact between the researcher and subjects

In order to be able to understand the answers in the questionnaires Q1, Q2 and Q3 and to interpret the thinking processes of the subjects translating their opinions into the questionnaires, the researcher had to be present during all meeting sessions. Due to the continuous presence of the researcher, a kind of relationship developed between the researcher and the subjects. For instance, some test persons apologized for not having any preference for a specific colour or for preferring the neutral 'reference' room (see case 11). It seems that these subjects assumed that the researcher was expecting them to have a colour preference or that the researcher had a colour preference herself. Indeed, when the researcher asked subjects if they thought that the researcher expected that colour had any effect, all subjects answered positively. Probably these ideas have influenced the opinion of the subjects and the responses to the questionnaires. It is possible that more subjects mentioned a preferred colour than they otherwise would have done. This phenomenon is known as the interviewer effect (Choi, 1975).

These considerations have to be taken into account in colour research. The colour research process itself is complex and process aspects such as time and role of the interviewer, both possibly influence the results.

Conclusions and recommendations

It can be concluded that the responses to questionnaires are not always a clear representation of subjects' opinions. Using these answers in colour research, it is not in all cases possible to draw valid conclusions on the colour influences. The responses to the questionnaires Q1, Q2 and Q3 can be considered as a contamination of feelings, cognitive thinking and psychological considerations by the subjects.

All mentioned factors and phenomena have influenced the answers subjects completed in the questionnaires. It can be concluded that responses to questionnaires used in colour research in real life settings are a result of complex considerations, which makes it difficult to draw clear, reliable and valid

conclusions about the influences of colour. The present research in a real life situation showed evidence about the risks of wrong interpretations of data from questionnaires. Questionnaires alone are not valid instruments to give a clear insight into the influences of colours applied in the physical environment in real life situations. A general recommendation not only concerning colour research but concerning research in general making use of questionnaires is to include other sampling techniques. For instance making use of beeping from a pager to define the moments that participants are asked questions with relatively quick responses reduces the effects of influences of context factors (Csikszentmihalyi, 1999).

Some specific recommendations can be given to conduct colour research in real life situations that more clearly indicate influences of colours. The context has to be kept simple. It is important to locate the test rooms in the inner space of the building in order to avoid the impact of changeability of daylight. Real life settings within an organizational context can bring a range of emotional, social and organizational aspects that may influence the answers to questionnaires. As such, questions that could be related to this complex context should be avoided while questions concerning personal aspects are more preferable. Due to the often white (Kwallek,1990) and colourless environments in offices, a period of at least three months is necessary to get accustomed to the test colours. The chance that subjects will guess the research topic will be smaller and subjects will experience the surrounding colours in a more natural way and less as a special test event.

The influence of the presence of the researcher –to be able to observe what is going on – could be avoided by using cameras. However, this also could influence respondents' behaviour as well. Physiological measurements, which easily can be applied without any bodily irritations or barriers, like measurement of Galvanic Skin Response, could be added for reasons of triangulation. If these kinds of measurements and responses to questionnaires result in similar findings, reliability and validity of the conclusions will be improved. When using questionnaires, it is recommended to interview subjects directly after completing the questionnaires to get a better understanding about motives. Taking all these recommendations into account, the possibility exists of finding the real influences of colour.

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