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Users' Demands Regarding Dental Safety Glasses. Combining a Quantitative Approach and Grounded Theory for the Data Analysis

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Eye infections are common among dentists and many are concerned, but few are using proper eye protection. To understand users' demands behind the low use of safety glasses, all dental teams in Sweden were asked which factors they found most important when choosing dental safety glasses, and rate the importance of 31 statements regarding ergonomic aspects of dental safety glasses in a questionnaire. Data were analysed using the Grounded Theory and a quantitative approach. Results showed that dentists ranked the visual aspects as most important and chair assistants the protective aspects. The highly visual demanding work performed by dentists requires safety glasses that are not yet available on the market, which might explain the low use.

dental safety glasses users' demands qualitative and quantitative methods

1. INTRODUCTION

Dental personnel are occupationally exposed to ocular hazard when using rotary instrument and handling chemicals, but also due to exposure to micro-organisms and radiation. The most common ocular injuries are mechanical trauma, according to Bezan and Bezan (1988). However, the extensive use of polymer materials is an increasing hazard as these materials are well-known irritants to skin, eyes, and respiratory tract, but also can cause allergic

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reactions (Jolanki, Estlander, Suhonen, Henriks-Eckerman, & Kanerva, 1994; Kanerva, Estlander, Jolanki, & Tarvainen, 1995; Kanerva, Jolanki, & Estlander, 1997; Savonius, Keskinen, Tupparainen, & Kanerva, 1993). No statistics are available regarding eye infections among dental personnel in Sweden. The first study reporting about high prevalence of eye infections among dentists was a questionnaire study including all dental team in Northern Sweden and a referent group (1,172 respondents, response rate 76%) by Lönnroth and Shahnava (1998a). Commonly known among medical researchers is the gender-based bias that females tend to report more symptoms than males, which was also shown in that study. However, eye infection was strongly associated with working as a dentist. Significantly more dentists (female 18.4% and male 16%) reported eye infection than did referents (female 3.5%, male 1.3%) and chair assistants (female 3.3%). Further, the eye symptoms were not correlated with age, sex, or working hours per week (Lönnroth & Shahnava, 1998a). An extended study including all Swedish dental team in general practice (7,384 respondents, response rate 70.3%) verified the strong correlation between eye infection and working as a dentist, even though the prevalence was somewhat lower. In that study 14.1% of female dentists and 10% of male dentists reported experience of eye infection compared to 4.8% of chair assistants. Additionally, significantly more dentists than chair assistants had consulted a physician due to eye infection (Lönnroth & Shahnava, 1998b). This indicates the need for eye protection among dentists.

Limited types of dental safety glasses like goggles or a visor are available in many dental clinics but few Swedish dental personnel are using them. Based on a previous observation study conducted in Northern Sweden it was shown that even though dental personnel considered it important, nobody used safety glasses but ordinary spectacles as safety glasses. A single dentist occasionally used a visor (Lönnroth & Shahnava, 1997). This was verified in the national study (7,384 respondents) where almost 90% considered it very important for the dentist to use protective glasses, but less than 20% used them and almost 60% reported using prescription spectacles as protective glasses (Lönnroth & Shahnava, 1998b). To answer the question why dental personnel do not use safety glasses, as well as which characteristics of safety glasses they consider most important, dental personnel were asked to name which factors they considered important when choosing dental safety glasses. Additionally, they had to rate the importance of 31 statements regarding ergonomic aspects of dental safety glasses. Due to the great number of completed questionnaires returned, and

a wide variation of different responses to the open question, we decided to make use of the Grounded Theory approach. Glaser and Strauss (1967) introduced this qualitative method as an alternative strategy to more traditional approach. However, the approach has been subject to debate for several years (Babchuk, 1996).

2. AIM

The aim of this study was to assess which ergonomic factors dental personnel considered as most important when choosing dental protective glasses. An additional aim was to try to combine and use a qualitative and quantitative method to get a broader understanding of the users' demands.

3. PARTICIPANT AND METHODS

Mailed questionnaires were sent to all dental teams (dentist and chair assistant) working in general dental practice in Sweden. After one reminder, 7,384 dental personnel responded to the questionnaire, 4,293 dentists (male 54.7% and female 45.3%), and 3,090 chair assistants, which gave a response rate of 70.3%. In an open question dental personnel were asked "Which factors do you find most important when choosing safety glasses for your dental clinic?" The qualitative method called Grounded Theory was used for analysing the open question. Words from about 50 questionnaires were grouped into codes, and codes into categories, which formed the two axes (*functional demand* and *human factors demand*). Later a typology model with four combinations was developed. After the model was built, words from another 200 questionnaires were used to verify the model. All words could easily fit into the model and the model was considered grounded.

One part of the questionnaire dealt with 31 statements regarding ergonomic aspects of dental safety glasses. Respondents were asked to rate the importance of each statement from *very important* to *not important at all* on a scale from 1 to 4 with *very important* ranked as 4, *fairly important* as 3, *not very important* as 2, and *not important at all* as 1. The percentage answering 4 (*very important*) was calculated for each question and for dentists (male and female) and chair assistants separately. The questions were then grouped into the four codes found from the Grounded Theory analysis (*individual protection*, *work performance*, *emotional demand*, and

demand. *Individual protection* was based on words like protect against splash, UV light, filter all hazardous radiation, tight on sides, tight fitting, protect whole face, protect from sides. *Work performance* was based on words like good optic glasses, with correction for near and long sight, provide good colour visibility, resistant to scratches, give maximum field of vision, no reflection frame, not steaming up when combined with face mask. *Rational demand* was based on practical aspects like easy to wear and use, easy to clean, easy to put on and off, give freedom in work, compatible with face mask and prescription spectacles, changeable lenses if scratched, removable side shields, not causing allergy. *Emotional demand* was based on words like look nice, individuality, discreet, not too tight, not look like protective glasses, make you look good, available in many colours, not frighten children, not give patient the impression that aesthetics is not important.

The four codes were found to belong to two main categories, *functional demands* and *human factors demands*. *Functional demands* could form one axis with *individual protection* at one end and *work performance* at the other end. *Human factors demands* could form the other axis with *rational demand* at one end and *emotional demand* at the other end.

The two main categories could form a model with four combinations, as shown in Figure 1. The axes represent a continuum and show the possible variation between the extremes in the model.

After the model was designed, words from another 200 randomly selected questionnaires were used and it was found that they could easily fit into the model. Thus, the model was considered verified and the analysis grounded.

One part of the questionnaire included 31 statements regarding ergonomic aspects of safety glasses. Respondents were asked to rank these statements from *very important* to *not important at all* on a scale from 1 to 4 with 4 as *very important* and 1 as *not important at all*. The percentage answering 4 (*very important*) was calculated for each question and with regard to profession and sex. Further, the statements were grouped into the four codes found from the Grounded Theory and a mean value was calculated for each code, and for dentists (male and female) and chair assistant separately.

1. *Individual protection* included the following statements:

Dental safety glasses must protect the eyes from

- flying particles,

- splash,
- radiation,
- vapour,
- bacteria,
- UV light,
- blue light,
- ordinary light,
- must be tight.

2. *Work performance* included the following statements:

Dental safety glasses must

- be provided with correction for vision;
- be provided with correction for vision, no matter the cost;
- be of high optical quality;
- be of high optical quality, no matter the cost;
- give maximum field of vision;
- be scratch resistant;
- be scratch resistant, no matter the cost;
- not steam up.

3. *Rational aspect* included the following statements:

Dental safety glasses must be

- easy to combine with prescription spectacles;
- easy to combine with face mask;
- made for long-term use;
- adjustable;
- cover everything, for example a visor;
- made of non-allergenic material;
- cheap;
- easy to clean.

4. *Emotional aspects* included the following statements:

Dental safety glasses must

- be small;
- have a modern design;
- have a discreet design;
- have an aesthetic design;
- have an aesthetic design, no matter the cost;

- be made of recyclable material;
- be available in many colours;
- be comfortable;
- be light;
- be disposable.

To assess if there was any difference in demand between dentists and chair assistants, and males and females, the mean values of the four codes were compared. As shown in Table 1, females ranked all aspects as more important than males did. When choosing females and comparing professions, dentists ranked all aspects except individual protection higher than chair assistants did.

TABLE 1. Mean Value Based on the Questions in Each Code, and With Regard to Profession and Sex

Demands	Abbreviation	Male Dentists <i>n</i> = 2,348	Female Dentists <i>n</i> = 1,945	Chair Assistants <i>n</i> = 3,090
Individual protection	IP	36.7**	50.5*	55.8
Work performance	WP	53.8**	61.2*	51.2
Rational aspects	RA	43.8**	54.6	52.1
Emotional aspects	EA	21.7**	28.2	26.8

Notes. * significantly higher ranking by dentists when comparing female dentists and chair assistants, ** significantly lower ranking by males when comparing male and female dentists.

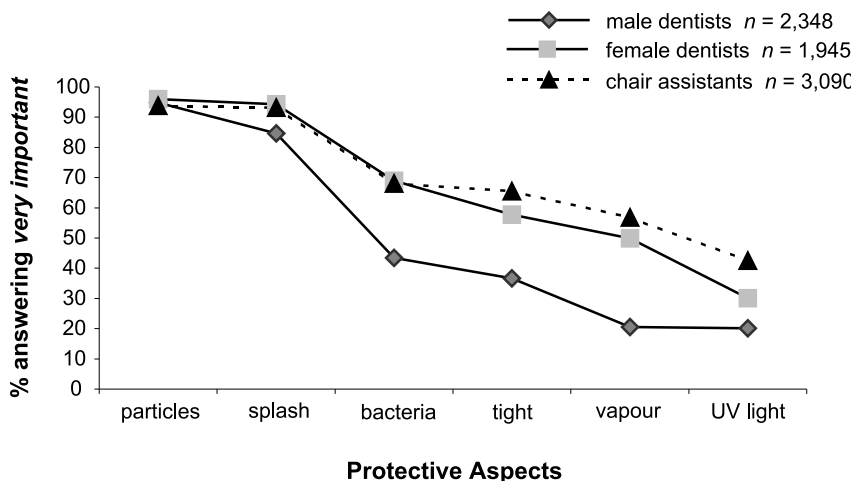


Figure 2. The most important statements regarding protective aspects, according to dental personnel.

Further, the questions in each code (*individual protection* [IP], *work performance* [WP], *rational aspect* [RA], and *emotional aspect* [EA]) were ranked, and with regard to profession and sex. Figures 2–5 show the six most important statements in each code as reported by dental personnel ($n = 7,383$).

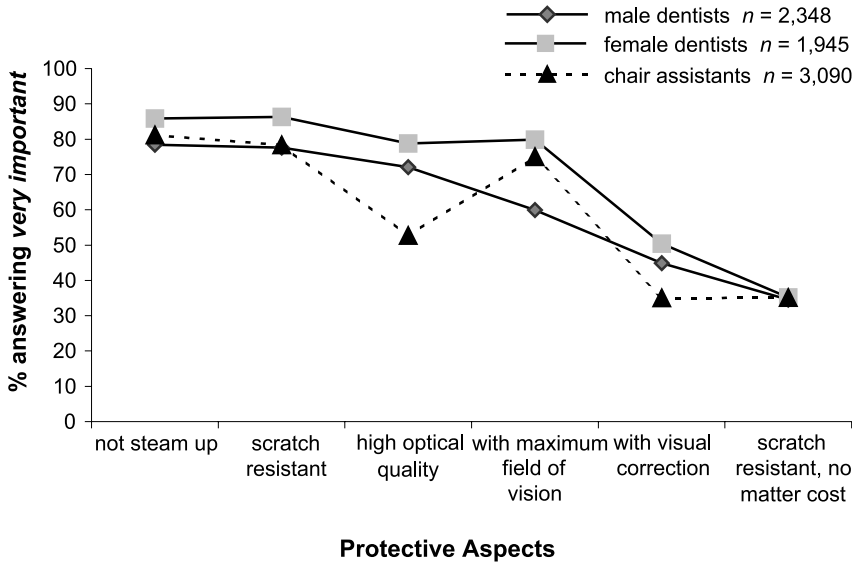


Figure 3. The most important statements regarding work performance, according to dental personnel.

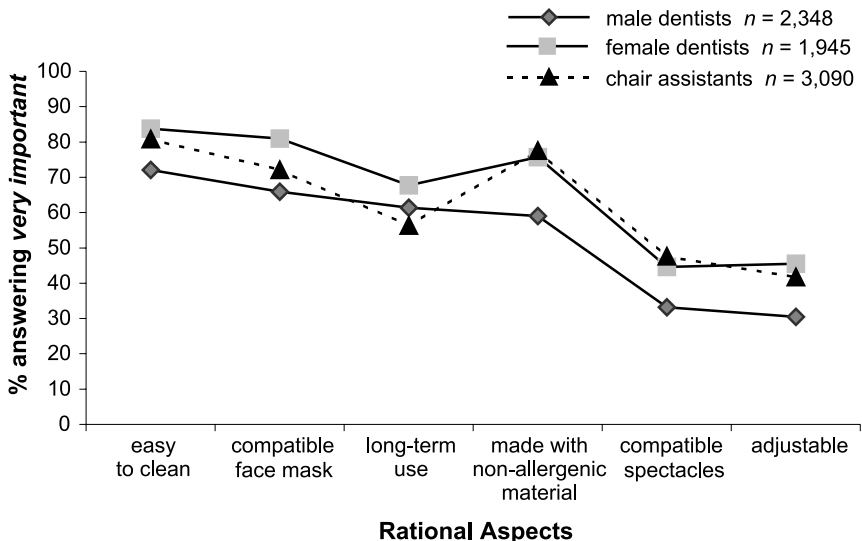


Figure 4. The most important statements regarding rational aspects, according to dental personnel.

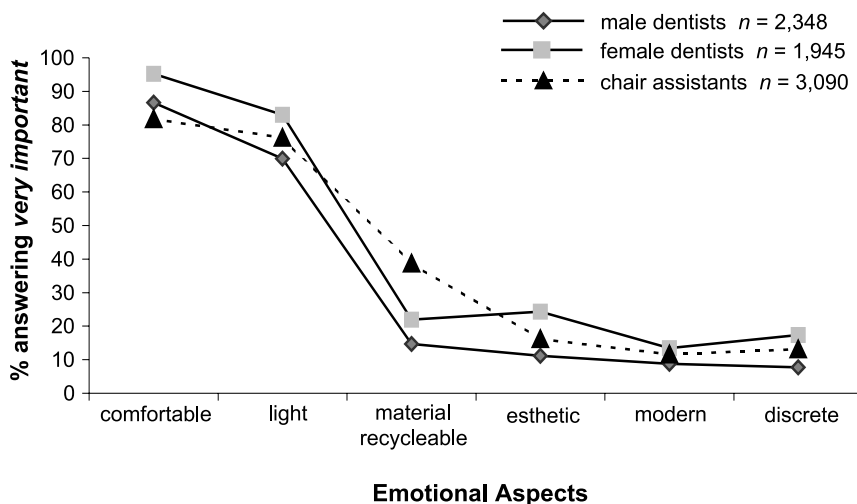


Figure 5. The most important statements regarding emotional aspects, according to dental personnel.

The two main categories, *functional demand* and *human factors demand*, could form the two axes of the model (see Figure 1) giving four combinations: IP + EA, WP + EA, IP + RA, and WP + RA. The mean values from the two codes were added, see Table 2, and the combinations were ranked.

TABLE 2. Summary of Mean Values for Each Combination With Regard to Profession and Sex

Combining Functional and Human Factors Demands	Male Dentists n = 2,348	Female Dentists n = 1,945	Chair Assistants n = 3,090
IP + EA	58.4 (36.7 + 21.7)	78.7 (50.5 + 28.2)	82.6 (55.8 + 26.8)
WP + EA	75.5 (53.8 + 21.7)	89.4 (61.2 + 28.2)	78.0 (51.2 + 26.8)
IP + RA	80.5 (36.7 + 43.8)	105.1 (50.5 + 54.6)	107.9 (55.8 + 52.1)
WP + RA	97.6 (53.8 + 43.8)	115.8 (61.2 + 54.6)	103.3 (51.2 + 52.1)

Notes. IP—individual protection, WP—work performance, RA—rational aspects, EA—emotional aspects.

When ranking the four combinations, it was shown that both female and male dentists ranked *work performance* and *rational aspects* highest, compared to other combinations, which were ranked similar. The following trend in ranking was evident: WP + RA ⇒ IP + RA ⇒ WP + EA ⇒ IP + EA. Chair assistants ranked *individual protection* and *rational aspects* highest such as

$IP + RA \Rightarrow WP + RA \Rightarrow IP + EA \Rightarrow WP + EA$. Further, all combinations including *rational aspects* were ranked higher than the combinations including *emotional aspects*.

5. DISCUSSION

As 7,384 questionnaires were returned with a wide variation of different answers to the open question, the Grounded Theory was considered to be an appropriate approach for analysing the data. About 250 questionnaires were used and all the words could easily fit into the model and verify the model that was considered grounded. Glaser and Strauss introduced this qualitative method in 1967 as an alternative strategy to a more traditional approach. However, for several years they have not been able to agree on the understanding and approach of using the Grounded Theory (Babchuk, 1996).

The large number of respondents and a response rate of 70.3% were considered acceptable for the quantitative part of this study. A more fruitful approach might have been starting with the open question in a smaller study, and then, on the basis of the result, designing statements for a questionnaire study. However, due to a time limitation this was not possible.

As shown in the model, dental safety glasses must fulfil a wide range of demands regarding functional and human factors aspects. However, it was possible from the quantitative analysis of the statements to find that most dentists want safety glasses that “provide good vision” and are “easy to wear and use” followed by “give good protection” and “easy to wear and use.” As the model is dynamic it shows possible variations between the extremes. The result might reflect different demands with regard to age. As presented in another paper (from the same study) by Lönnroth and Shahnavaz (1998b), protective devices are used by more younger dentists than older ones, and more older dentists use prescription spectacles, and probably focus more on the visual aspect. Further, dentists with eye symptoms might also be more focused on the protective aspect of safety glasses, as eye symptoms were more prevalent among those wearing eye protection of some kind, than those without (Lönnroth & Shahnavaz, 1998b). Even though very few chair assistants reported eye problems, most of them wanted safety glasses that provide individual protection and are easy to wear and use, which might reflect a concern about the work environment.

For dentists the visual aspect is most important. However, with regard to professionalism, the aesthetic is also important from many aspects as shown by the answers “not give the patient the impression that aesthetics is not important,” “make good impression on patients,” “not appear strange,” “not frighten children,” “make me look nice,” and “not look like protective glasses,” among others. The result also supports the opinion of offering several types of dental safety glasses to meet different individual demands and professions. Further, to convince dental personnel to use safety glasses, more appropriate education and training is needed. The training needs to be tailored to the different user groups. This also emphasizes the ergonomic principle of knowing the users' needs and characteristics in promoting and maintaining safety procedures.

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