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Design for Health

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rfdh20

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To cite this article: Catherine Stones, Wenbo Ai, Sophie Rutter & Andrew Madden (2022) Developing novel visual messages for a video screen hand sanitizer: a co-design study with students, Design for Health, 6:2, 185-203, DOI: 10.1080/24735132.2022.2095760

To link to this article: https://doi.org/10.1080/24735132.2022.2095760

DESIGN FOR HEALTH
2022, VOL. 6, NO. 2, 185–203
https://doi.org/10.1080/24735132.2022.2095760

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Developing novel visual messages for a video screen hand sanitizer: a co-design study with students

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ABSTRACT

This paper reports on the results of a series of co-design workshops devised to generate new messaging ideas for a novel hand sanitizer unit that features a video screen and feedback system. Students of different nationalities, ages and genders were involved in the process either to prime design sessions, or devise/evaluate new ideas for the screen to display in a university setting. The project aimed not only to produce animated designs for subsequent testing but also to elicit key preferences for hand hygiene message tone, content and visual appearance. Research findings revealed a clear preference in the student community for positive, caring and playful approaches to hand hygiene messaging in contrast to many messaging approaches featured in previous studies. In terms of visual approach, students expressed a preference for colourful illustrations rather than photographs or word-based messages. The paper highlights some particularly rich ideas developed to exploit the novelty of the device, such as specific animated sequences or immediate visual rewards of internet memes as ways to engage the student audience. Co-design proved valuable in devising new insights for the hygiene communication community.

ARTICLE HISTORY
Received 14 January 2022
Accepted 6 June 2022

KEYWORDS
Hand hygiene; communication design; motion graphics; co-design

Introduction

Practicing hand hygiene (HH) in educational environments is vital for reducing infection. For example, White et al. (2003), in an intervention study in an HE setting found improved hand hygiene resulted in fewer upper respiratory–illness symptoms, lower illness rates, and lower absenteeism.

The paper reports on the findings of a project that utilized co-design methodologies with students to generate new HH messages for a new

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Supplemental data for this article is available online at https://doi.org/10.1080/24735132.2022.2095760.

intervention. Creating a new persuasive intervention involves a three-step process made up of:

1. Selecting/writing messages;
2. Designing the visual components of the messages; and
3. Testing message impact on hand hygiene levels.

This paper focuses on the first two steps, providing useful insights for researchers at the initial stage of their intervention development.

The project involved use of a novel video screen-based hand sanitizer system able to provide real-time visual feedback. The research team was challenged to develop designs for an innovative hand sanitizer (see Figure 1) developed by Savortex, a UK-based hygiene device manufacturer, and to create new design insights and knowledge about how such systems could be used in an educational setting. The study described here formed part of a larger funded project and sought to address the following research questions:

1. What are students' preferences for *message tone* in a HH context?
2. What are students' content and stylistic preferences for HH messaging?
3. Can co-design methods offer novel solutions in the development of motion-led and interactive HH messages?

Figure 1. Novel hand sanitizer units by Savortex.com (copyright held by Savortex.com – reproduced with permission).

The purpose of this paper is not to ascertain the effectiveness of the novel messages but rather to present the student voice in terms of preferences and to contribute and analyse messaging ideas generated by the intended audience. We speculate that co-design methods would provide messages that move beyond previous approaches tested in the academic literature.

Context of the study

Identifying the knowledge gaps

Our study fills two key gaps in the health design research field. While video screens have been used in previous hand hygiene projects to allow for easy message alternations, few studies exploit the moving image capability of the video screen, despite its widespread adoption in, for example, the advertising industry. Pereira, Ayanoglu, and Duarte (2020) highlight the potential use of large scale video screens for hand hygiene messaging in a clinical setting however the video was not used at the point of hand sanitization. Rapid visual change caused by flashing lights on sanitizer units has been shown to have a positive effect on HH compliance in clinical settings (D'Egidio et al. 2014). Stella et al. (2019) also suggested that animated images might have had a stronger effect than the static image they tested in a hand hygiene study. Further investigations, then, into the potential use of motion in HH communication seem a valid and necessary area of study.

This study also sought to elicit further design concepts for real-time visual feedback on the screen. Gaube et al. (2018) had previously shown in a pilot study that real-time visual feedback when hand sanitizers were used increased compliance in a clinical setting. Gaube et al.'s (2018) study, that utilized still images only, provided a point of departure, challenging us to develop a much wider set of creative ideas both in terms moving image and feedback motifs.

Co-designing hand hygiene communications

Co-design provides an approach for developing hand hygiene messages. The primary concept behind co-design refers to designers and non-designers working creatively together in the design development process (Sanders and Stappers 2008).

Co-design is already shown to be a useful process in the development of health-related information. Harrison et al. (2020), for instance, found that an infographic co-created with users significantly raised knowledge and self-efficacy values. Equally, involving students in the construction of health-related interventions is valuable in developing interventions that are based on the attitudes, views and needs of its key audience. O'Connor and Andrews

(2016) gained key design insights by co-designing with students to develop clinical training apps and Haraldseid, Friberg, and Aase (2016) identified new student-learning needs through an iterative process of co-design with nursing students.

A number of studies highlight the value of co-designing HH inventions with non-student audiences. Rutter et al. (2020) outline the positive effects of a HH intervention developed with children that significantly reduced instances of dirty hands and increased soap usage. Lambe et al. (2021) collected stakeholder attitudes and views towards HH inventions to inform future intervention development. Pittet et al. (2000) used co-design strategies to develop a series of HH promotional posters with staff and HH levels raised as a result. Despite the reported potential of engaging with users to develop HH interventions, HH studies set in higher education focus on testing single or a series of interventions developed without clear student input. Lawson and Vaganay-Miller (2019) found that a 'self-designed' poster had no significant effective in raising hand hygiene compliance in a university setting. Mackert, Liang, and Champlin (2013) developed HH posters with some student input (though unclearly defined) and these improved soap usage but not overall hand washing.

To the authors' knowledge, co-design approaches to HH intervention development in a higher education setting are under-utilized, despite showing much potential with other audiences/settings. It seems both logical and important to include students, the key stakeholders, as a fundamental part of the design of a new HH messaging device.

What messages/approaches have already been effective?

Various theoretical approaches have previously been used for guiding the design of hygiene messages, for example, the theory of behavioural change (Clayton and Griffith 2008), nudge theory (Caris et al. 2018) and principles of persuasion (Gaube et al. 2020). Theory led the priming stage of our co-design process (as explained in the methodology section). Comparisons of gain-framed vs loss-framed messages are also used to structure HH research (Updegraff and Rothman 2013). As such variously framed messages were used in the priming survey outlined below.

In terms of image testing, previous work has shown that messages based on principles of social norms, disgust, knowledge/reminders, monitoring and feedback can be successful in raising HH compliance levels. Translated into designs by researchers, the following approaches have been shown to be successful: text asking whether the person next to you is washing their hands (Judah et al. 2009), images of eyes (Pfattheicher et al. 2018), images of a 'faeces sandwich' (Porzig-Drummond et al. 2009; Rutter et al. 2022), images

of germs on a hand (Dubner and Levitt 2006) and statements of fact – 'Water doesn't kill germs. Soap does' (Judah et al. 2009).

There is a large literature base for discerning which hand hygiene messages result in greater hand compliance, most of which are based in a clinical setting. Such studies underpin some methodological decisions in our work, namely the priming exercises conducted with students. These studies involved repeat testing of static motifs often informed by the same theoretical frameworks related to behaviour change. As such we sought to break the cycle of standard motifs via the introduction of a novel sanitization device and co-design methodologies with students. What other messaging strategies could a novel technology initiate?

Methodology

A co-design methodology was used to develop design solutions for a newly developed hand sanitizer unit with a video screen capable of displaying real-time visual feedback (see Figure 1). A series of co-constructed design activities was developed to probe, prime and generate, following broadly Sanders, Brandt, and Bilder's (2010) *well-established framework of participatory design. Iterative loops, as used by* Yoo et al. (2020), informed our approach to development and evaluation – participants could comment on and build on each others' work across several workshops.

Table 1 outlines the stages of the co-design methodology though this paper focuses on the outcomes of the idea generation stages (2 and 4), to more deeply reflect on student-led insights.

Table 1. Methodology overview.

Stage	Method	Participants	Purpose
1 Discover (A)	Priming survey	26 responses (18-24 years old)	To gain preliminary views from students' regarding hand sanitation messages, tone and visual approach.
2 Generate (B)	Workshop 1	5 graphic communication/ design students (18-24 years old)	To share survey results with the student design team To reflect on priming insights To introduce the novel HH technology To discuss initial ideas / issues To generate Ideas through sketching To share and discuss ideas
3 Define	Design development	2 design researchers (Project PI and PGR)	To thematise ideas generated To develop mock design from students' ideas
4 Develop	Workshop 2	26 students from a range of backgrounds (17−39 years old average age 22−23) (5 participants participated through email only)	To gain feedback on mock design prototypes To generate new ideas or extend existing To select the top visual messages with the most potential
5 Delivery	Final design stage	2 design researchers	Develop final motion graphic visual messages

Students (both design and non-design students) were recruited, via email, to participate in the survey and in online workshops. International students from Asia and home students from the UK were participants for the fourth stage. The work was approved by the lead university's ethics approval committee. A range of students was selected, with different students utilized at each stage to maximize the variety of student participation (see Table 1). Our recruitment strategy involved students from a range of countries, ages and chosen to represent the diversity on campus. All workshops occurred online due to Covid restrictions.

During the different stages various of tools and methods were used to enhance empathy, provide inspiration and support engagement (Sleeswijk Visser, Van der Lugt, and Stappers 2007). For example, icebreaker sessions at stage 2 enabled participants to share their own experiences of HH, at stage 2 students were able to share their own inspirational examples and, at stage 4, rough mock-ups were used to encourage drawing without quality judgement. Themes were identified by researchers by iteratively analysing sketches and transcripts *(see below for further detail)*. Prototypes based on these themes were then used as visual 'provocations' to encourage feedback. Finally, we used a shared decision-making process (Akoglu, Dankl, and Steffensen 2019) to select visual messages.

Priming survey: methodology and findings

An online survey was designed containing 19 questions and circulated to an existing undergraduate email list within the School of Design. The full collection of survey questions can be found as an additional supplementary file. The primary aim of this survey was to gather preliminary views of students in relation to HH messaging. The survey results served as a qualitative priming information, used during the first co-design workshop rather than to collect independently significant quantitative data. The survey provided a broad base of views on which to generate ideas at the first workshop session. The 26 survey respondents therefore shaped the idea generation stage by proxy.

Key sections of the survey featured questions about both content (the message and its tone) and visual design (the style of the image). In each case, students were asked to choose which they considered to be most effective in encouraging hand hygiene.

Key survey content is outlined below:

- A range of text-only messages influenced by previous studies and theories (eg social norms, knowledge acquisition, feedback, disgust and

consequence) were featured and students had to choose and justify their choice of messages they considered to be most effective.
- A range of potential image descriptions.
- Various message tone descriptions and visual stylistic choices.
- As an example question, students were asked: Which style of message would be most effective in encouraging you to use hand sanitizer on campus? (you can select more than one answer). The choice consisted of the following: Text only, Scientific photographic image, Everyday photographic image, Serious illustration, Fun cartoon, I do not know, It does not matter.

See Table 2 for key results. The main findings were as follows:

In summary the priming stage demonstrated that the students who participated in the survey preferred positive, friendly, fun and motivational message tones. Visual approaches were important, with an emphasis on the use of illustration. An immediate feedback system appeared highly valued. Negatively framed messages or those judging social norms (such as being watched or being compared to others) performed poorly in the survey and thus were equally useful for the priming stage, highlighting communication approaches to avoid. The data from the questionnaire formed a user-centred-criteria to guide subsequent design decisions.

Workshop 1 – methodology and findings

After the priming survey stage, two 1 h online workshops occurred with five different student volunteers from graphic communication design backgrounds. Low numbers of participants, typical of qualitative research, allowed for the inclusion of each student in discussion. Graphic design students were chosen for their ability to draw and rapidly generate ideas.

In order to prime participants (eg, to trigger design thinking prior to the workshop) participants were asked to pay attention to hand sanitizer dispensers in public spaces and to perform some basic visual research online. Participants then shared their collections in the group discussion as an ice-breaker. This co-creation framework of 'tell-make-enact' (Brandt, Binder, and Sanders 2012) was used successfully in this session for students themselves to guide early thinking. The results from the stage 1 survey were also shared and this aided understanding of the wider context of student views. Students were then asked to draw and verbalize their ideas. After the drawing session they gave short presentations and commented on each other's work.

A total of 23 sketches were generated by the student participants. A selection of the sketches is shown in Figure 2.

Table 2. Priming survey results.

Message preference **(select one only)**	% Selected
'Only 50% of you sanitized yesterday' (feedback)	26.9
'Thank you so much for sanitizing today!' – a message triggered when sanitizer used (feedback)	19.2
'Clean hands keep your loved ones safe' (gain frame – consequence)	15.3
'There are more germs on your phone and keyboard than a toilet seat.' (disgust)	15.3
'Clean germs off your hands or eat them later' (disgust)	11.5
'Nearly 80% of common infections are spread by your hands' (knowledge acquisition)	7.6
'Your friends are watching you!' (monitoring)	2.6
'Dirty hands put your friends and family at risk'(loss frame – consequence)	0
'Clean hands can reduce sickness by 21%.' (knowledge acquisition)	0
'Are your hands as clean as your classmates' or colleagues'?' (social norm)	0
Image preference (rating)	% Rated good or very good
A fun image, connected to hand hygiene	57.7
An image of a hand showing the transfer of germs via things it touches	53.8
An image that shows how to clean your hands effectively using hand sanitizer	38.4
An educational image showing scientific health promotion information.	26.9
A purely attention grabbing flashing pattern.	23
A fun image, unconnected to hand hygiene	19.2
An image of people at university	3.8
Visual approach preference *(multiple selections allowed)*	% Selected
Fun cartoon	57.6
Serious illustration	38.4
Text only	30.7
Everyday photographic image	23
It does not matter	15.3
Scientific photographic image	11.5
I do not know	3.8
Other	0
Tone preference *(multiple selections allowed)*	%
Positive – highlighting benefits	26
Friendly / supportive	22
Funny / informal	19.6
Trustworthy / educational	14.7
Negative- warning of risks	9.8
Strong-commanding	4.9
It does not matter	1.6
Neutral	0
I do not know	0
Other	0
Emotional preference *(multiple selections allowed)*	%
Motivation – feeling motivated to sanitize	18.2
Caring – feeling that you care for those you love: classmates, friends and families	15
Satisfaction – eg, feeling content that hands are clean	10.7
Confidence – eg, feeling confident that you can keep hands clean	10.7
Empowerment – eg, feeling that you are in control of your own cleanliness	9.6
Guilt – eg, feeling bad if you don't sanitize	9.6
Belonging – eg, feeling that you are part of team keeping hands clean	6.4
Joy – eg, feeling happy that you are keeping hands clean	4.3
It does not matter	1
Other	1
I do not know	0

Figure 2. Selective drawings from workshops highlighting procedural (left), personified (centre) and reward (right)-based approaches (reproduced with permission).

By gathering and analysing the sketches some patterns emerged. The use of animated germs and animated objects, that were often personified, was the most dominant trope in the student work. The use of human faces and hands was also featured in many of the solutions often in light-hearted ways.

The notion of immediate feedback provoked novel responses. Perhaps the most novel idea (shown in Figure 2 right) involved the use of random feedback whereby students using the hand sanitizer would be 'rewarded' by the display of a funny/entertaining internet meme. This provided a very different and youthful approach to hand hygiene messaging, a point returned to later in the paper.

Some images were more formal in their approach to the brief utilizing existing 'commanding' graphics. For example, a student created a 'stop and go' idea where a conventional traffic 'stop sign' would change to 'go' when the sanitizer was used. This was designed to encourage a physical pause in front of the unit before being authorized to proceed, acknowledging the physical journey involved in hand sanitization. Another student re-appropriated the standard food hygiene visual ranking scheme, animating it to signal a transition from low to high hygiene, while another presented a series of serious and procedural steps to take.

The student ideas often reflected the student survey results, focussing on preferences for positive approaches for their message design rather than negative risk warnings. Drawing as a method may place emphasis on interpreting ideas as positive and 'fun' given the ease of 'cartoon' type

production but in many cases, the very approach to the design of specific characters and personalization suggested a light-hearted messaging approach.

Design development

In preparation for the second co-design workshop, a short period of design development took place. Both researchers, through a series of discussions, examined student drawings/transcripts and the outcomes of the survey. The drawings/transcripts were inspected for common themes (eg, use of hands) and for new creative ideas that either targeted students well (informed by the survey results) or that hadn't been tested in previous studies (eg, the stop-go idea). Ideas also that particularly exploited the change of the screen (immediate feedback) were chosen to go forward. The design prototypes that were further developed were based on four visual student ideas that emerged from stage 2 drawing and three ideas based on workshop verbalization.

1. Personified and animated germs – germs disappear when used (based on student drawing)
2. Stop and Go Sign – sign turns around when used (based on student drawing)
3. Hand Hygiene Level 1–5 Diagram – moves from 1 to 5 when used (based on student drawing)
4. Sanitize for a Surprise – internet meme revealed when used (based on student drawing)
5. Keep Uni Safe (based on student verbalization from workshop)
6. Don't take the virus as a gift to your party (based on student verbalization from workshop)
7. Funny Internet Meme (based on student verbalization from student workshop)

The aim of generating these mock prototypes (four of which are shown in Figure 3) was not to create professional design outcomes, but to visualize students' preliminary ideas. Acting as visual prompts, these visuals were developed to stimulate critical evaluation, expansion and further new ideas within Workshop 2.

Online feedback and selection – method and findings

Seven online feedback meetings with a total of 21 participants were organized. Such participant numbers ensured a high quality of debate in the hour-long workshops. Participants came from a range of different backgrounds

Figure 3. selective mock prototype images (copyright held by author).

including the social sciences and scientific disciplines to capture broad perspectives evident in higher education. Eighteen participants were international students, allowing diverse cultural views to be represented. These meetings acted as reflective dialogues (Zamenopoulos et al. 2021) for students from different backgrounds to give feedback and make comments.

We designed an activity involving discussion which could reorientate itself when students contributed new ideas rather than drawing activities alone. During each session, we explained the research project and introduced the seven ideas outlined in the previous section. Anyone could contribute new, relevant or alternative messages at any time during the group discussion. At the end of the session, students were asked to vote for the top four messages, including any new ideas they had generated.

A number of patterns emerged from the student responses to the seven ideas, often echoing the priming survey.

Visual reward was highly valued as an idea. Triggered changes to the screen, highlighting the disappearance of germs, or the revealing of a fun and unexpected image were positively received. Positive phrases were used by students in response – expressing a potential sense of 'achievement' or 'accomplishment'. Motion seemed to promote a greater sense of reward – eg, a sign appearing to twist round once the unit had been used.

Images that featured students and referred to keeping the University safe were generally well received and several students responded positively to an image that helped them feel connected, demonstrating a sense of unity and responsibility. One student referred to the fact that the image of university students 'spoke to them'.

Students in the second workshop were keen to extend ideas in terms of encouraging broader participation with the student community. The concept

of using an internet meme was well received with students suggesting that a reward system based on '*sanitize for a surprise*' could involve students uploading their own content to appear when a unit is used (participant 19). Participant 11 also suggested further participation through student uploads.

Conversely more formal and authoritative approaches were less well received ('*stop and go*'). One student expressed a negative view towards this idea as it might provoke her to think 'Did I do something wrong?'

In addition to evaluating the seven prompt images students were encouraged to generate new ideas.

The importance of reward continued to be a dominant theme within ideas: students suggested prize draws or score accumulation by using the sanitization unit. More specifically the usage of a surprise or unexpected reward was also a theme further reflected in the new ideas. Here the vital ingredient was the 'reveal' when the unit is used. Suggested ideas included quiz Q&A or jokes and accompanying punchlines. In addition, fun and unexpected ideas such as fortune telling or Tarot cards demonstrate how the theme of 'consequence' can be translated into a more compelling realization than the more conventional health risk consequence usually shown in hand hygiene messages.

The participation theme also continued with the suggestion that students should create the HH campaign fully and be rewarded if their design was chosen. Having student generated communication, explicitly labelled as such it was suggested, could raise adherence levels among the wider student community.

Some further specific motifs were suggested – such as eyes moving or watching. These ideas built creatively on previous studies. New technology afforded creative additions such as eyes following the passer-by or blinking (participant 3 and 20). Co-design allows for the combination of ideas – the idea of watching, for instance, combined with internet memes, resulted in the suggestion of a famous image 'watching' – eg, Mona Lisa watches passers-by and smiles more after sanitization (participant 3).

Use of colour to attract attention was considered important. Interestingly, the Stop-Go idea was translated more purely into a colour-driven design with a red flashing light on the screen changing from red to green when used (participant 1) or the use of interchangeable warm gradients (red-pink-orange) to attract attention turning to green when the unit was used (participant 16). Attention, attraction and visibility were classed as valuable qualities.

To embrace multimodal solutions more fully, sound was suggested as offering a useful reminder to users – 'when people pass by it emits one short high-pitched beep to remind people to use it. After sanitization, the sound could become more positive' (participants 1,6,15). Concerns were raised

though regarding potential annoyance or unnecessary attention being drawn to the user.

More broadly, some design principles emerged from the second workshop regarding the design of messages for the hand sanitizer units. Participants recommended that motion-led messages should be short, simple and quick. In line with the priming survey results, messages should be playful, positive and tailored for the audience. There should be a clear focus on using movement to grab attention.

Due to the small size of a screen, in order to attract attention at a distance, the degree of visual changes within the motion graphic should be strong. Contrasting colours and changing patterns may also offer useful approaches to grabbing attention in the short period that people are close to the sanitizer unit.

Message selection

After the group discussion, students were asked to vote on all the ideas, including the new ideas they generated. The top messages selected were:

1. Sanitize for a surprise/Internet Meme (24 votes)
2. Let's keep Uni safe (15 votes)
3. 'Help' – attacking germs being destroyed (14 votes)

These were then developed into a set of animations for display on campus. See Figure 4 for a still-image of the animations. Forthcoming work will examine the impact of these on hand sanitizer usage.

Discussion

Research findings from surveys, workshops and online feedback meetings reveal similar preferences: students preferred positive, friendly, funny and even

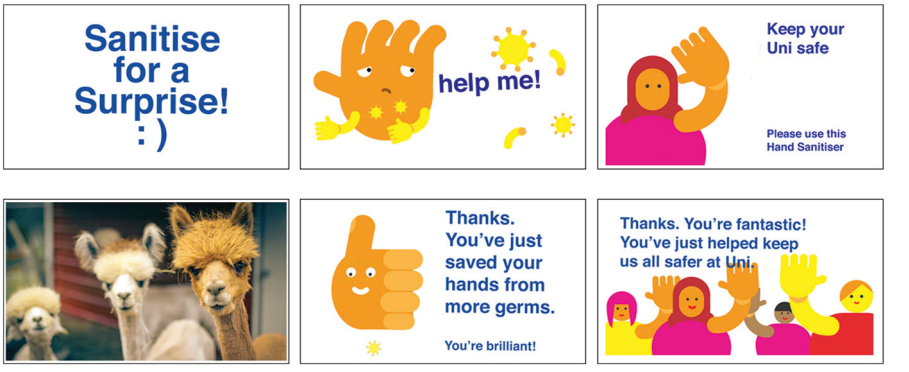

Figure 4. Developed motion graphics for display on the sanitizer unit screens (Animation stills – copyright held by author. Meme reproduced under the Unsplash Licence).

informal and irrelevant messages. This need for positive messaging expressed by students concurs with other broader studies. For example, positive-bias in messaging, drawing on principles of Prospect Theory (Tversky and Kahneman 1985), is already shown to be effective in promoting prevention behaviours (Rothman et al. 1999). The use of humour in persuasive brand campaigns has also been shown to trigger positive attitudes and actions (Strick et al. 2013). However, the messages evaluated in hand hygiene studies tend to be serious in tone. Jenner et al. (2005) highlighted the lack of research around humour and HH promotion and this remains an under-researched area.

There are also areas of commonality between the final designs and other HH studies. The sanitize for a surprise idea could be classed as an application of an Injunctive Social Norm principle (Gaube et al. 2020). Whereas social judgement was not well received as an approach, the lighter approach of reward was positively received. By building a feedback system that operates on the social and informal language of young people (eg, internet memes), the approval comes from the student body itself rather than from authority figures or the university itself. The student designers reward themselves with something directly from their community when they use the sanitizer. A key question leading from this is how would it be possible to ensure suitability of meme choice/surprise image given the varied demographic and cultural backgrounds of students? The notion of (supervised) student image uploading seems full of potential to maximize its relevance to students.

A sense of community evident through the animated message for 'keep your uni safe' also reflects the work of Pittet et al. (2000) whereby messages related specifically to the site of sanitization were featured. Inclusive images of students relate well to the images of the users of spaces within the posters tested by say Gaube et al. (2020). Though lowly ranked by students in the priming stage ('Images of people at University' was not classed as a motivating image), the use of more light-hearted and welcoming illustrations of students was more well received and developed further in the ideation and evaluation workshops.

Knowledge and reminders (that germs are present and can be removed) underpin the third most popular choice – 'help me'. Animation allows us to show a before-and-after scenario in real-time thus the visible removal of germs can be a powerful motif. We suggest that co-design has produced ideas that, whilst reflecting some established HH communication strategies, have allowed these to be extended and customized for a particular audience and setting.

Reflecting more broadly on the value of co-design for the participants during the study, more than half the students in the priming survey thought that students should be consulted/involved in the creation/choice of hand hygiene messages. The ideation and evaluation workshops saw high levels of

involvement, with some students following on afterwards with email commentary. Students appeared to appreciate engaging with the design of HH visual messages.

Conclusion

This study provides new insights into students' visual preferences for hand hygiene messages. It also offers new understanding of the affordances of a technological HH innovation (that allows motion and interaction) and presents new message ideas facilitated through co-design methods. By getting students to collaborate in the creation of visual messages it is possible to repopulate the pool of potential messages for subsequent intervention testing. This study does not aim to seek passive feedback from surveys or usage testing but instead to engage directly with the user on the very essence of the message being portrayed and ask 'what if?'.

In terms of responding to our initial research questions we can conclude, first, that the message and pictorial tone preferences for HH messages were overtly positive, friendly and/or funny. This was a preference that emanated from all the methods used in the study – the survey, workshop 1 and workshop 2.

Second, the preferences were for messages that were gain rather than loss framed, and ideas that highlighted feedback and reward. Illustration (whether humorous or serious) was the preferred visual style. Informal and even irrelevant visual approaches were suggested to regularly keep communication dynamic and surprising. Such preferences are somewhat 'at odds' with much of the HH design testing in academic literature indicating either that the preferred tones and styling of visual messages is highly context dependent (Kramer et al. 2021) or that the new technology has afforded more playful ideas than have previously been devised/tested.

Third, co-design with students has proved a useful method in stimulating innovative thinking in the area of HH promotion. This method has allowed us to move beyond more conventional approaches that are either instructional, photographic or icon-led, and instead look towards testing more playful solutions. The conceptual outcomes presented here – the notion of reward and surprise, the value of showing a before-and-after scenario at the moment of sanitization, and the potential of user participation in contributing directly to the message creation via uploads – move us into new messaging territory.

The study has a number of limitations. Like many co-design studies, numbers of participants are relatively low and as such, the study does not claim that *all* students preferences are outlined here. The ideas generated specifically address the opportunities afforded by a new hand sanitizer device with video screen and triggered visual responses and thus the realization of ideas could be considered limited. However, many of the ideas here, such as user

participation via uploads, or positively toned approaches can still be relevant to print-based campaigns.

It should be noted that this study did not focus on investigating whether message strategies should necessarily change due to Covid. It is important to acknowledge that the research took place during the third wave of Covid outbreaks in the UK so it is likely that ideas were shaped, consciously or unconsciously, by the 2020/2021 Covid pandemic.

We are not claiming that designs that are preferred or created by the audience are more effective at raising hand hygiene compliance. This remains a vital question. What this paper does contribute however are new and novel messaging approaches for strategies (eg, social norms) that have previously shown mixed results in HH compliance (Judah et al. 2009; Mackert, Liang, and Champlin 2013) and are thus worthy of further testing.

This work also raises further research questions: How will attitudes towards HH messaging and sanitization shift in the student community as Covid infections wain and/or other infections rise? Crucially, do co-designed messages work more effectively than more conventional theory-based messages at raising levels of hand hygiene compliance? How can more fully multimodal interventions involving, for example, sound be designed to maximize hand hygiene compliance? Our reliance on priming, whilst effective at grounding ideas, could also have shaped the ideation process through the power of suggestion.

We hope this paper helps other researchers/designers to better understand students' preferences for hand hygiene messaging. We suggest that health communication that involves a co-design process, whereby visual messages are created hand-in-hand with specific end users, is of high value in the generation of novel ideas.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was funded by Innovate UK Grant No. 84154. Many thanks to all our participants who gave their time and ideas to the study.

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