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A visual affective analysis of mass media interventions to increase antimicrobial stewardship amongst the public

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Objectives. In an innovative approach to improve the contribution of health psychology to public health we have analysed the presence and nature of affect within the visual materials deployed in antimicrobial stewardship interventions targeting the public identified through systematic review.

Design. A qualitative analysis focused on the affective content of visual materials garnered from a systematic review of antibiotic stewardship ($k = 20$).

Methods. A novel method was devised drawing on concepts from semiotics to analyse the affective elements within intervention materials.

Results. Whilst all studies examined tacitly rely on affect, only one sought to explicitly deploy affect. Three thematic categories of affect are identified within the materials in which specific ideological machinery is deployed: (1) monsters, bugs, and superheroes; (2) responsibility, threat, and the misuse/abuse of antibiotics; (3) the figure of the child.

Conclusions. The study demonstrates how affect is a present but tacit communication strategy of antimicrobial stewardship interventions but has not – to date – been adequately theorized or explicitly considered in the intervention design process. Certain affective features were explored in relation to the effectiveness of antimicrobial resistance interventions and warrant further investigation. We argue that further research is needed to systematically illuminate and capitalize upon the use of affect to effect behaviour change concerning antimicrobial stewardship.

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Statement of contribution

What is already known on this subject?

- The (mis)use of antibiotics and consequent risk of antimicrobial resistance is a critical public health problem. If sufficient action is not taken, global society will face the 'post-antibiotic' era, in which common infections will lead to death for many millions.
- Key desirable behavioural changes are decreased patient demands for antibiotics, use of them for targeted purposes alone, and compliance with prescribed dosing.
- There is a growth of interest in the role of affect in mass media interventions designed to engage publics and produce health-related behavioural change.

What does this study add?

- This article presents a novel analytic approach to understanding and intervening within behaviour change in public health that may complement other types of analysis.
- We present findings specifically from an 'affective' analysis based on semiotics in which we critically interrogated the visual imagery being deployed in mass media public health interventions concerning antimicrobial stewardship.
- Three thematic categories of affect are identified within the materials in which specific ideological machinery is deployed and that demonstrate some association with intervention effectiveness worthy of further investigation and testing.

The context for this study is the need for effective public health communications regarding antimicrobial resistance (AMR). The (mis)use of antibiotics and consequent risk of AMR is a critical public health problem (World Health Organisation [WHO], 2014). If sufficient action is not taken, global society will face the 'post-antibiotic' era, in which common infections will lead to death for many millions (WHO, 2014). This has led to calls for greater surveillance and – most significant in the present context – global public health awareness interventions designed to inform the public about the danger and educate them of how they might act to ameliorate the problem (O'Neill, 2016). Key desirable behavioural changes are decreased patient demands for antibiotics, use of antibiotics for targeted purposes alone, and compliance with prescribed dosing (O'Neill, 2016). Public health interventions designed to increase knowledge and effect behavioural change in this regard are critical because the overuse and misuse of antibiotics across human and animal help to drive AMR (O'Neill, 2016).

This article reports on one element of a systematic review of interventions designed to enhance antimicrobial stewardship amongst the public, that is, interventions designed to enhance knowledge of AMR, engagement with the topic, and effect behavioural change with regard to inappropriate antibiotic use. Specifically, we present the findings from an innovative analysis of the affective qualities of the visual materials deployed in antimicrobial stewardship interventions, with other elements of the systematic review reported elsewhere (McParland *et al.*, 2018; Price *et al.*, 2018). This article presents the findings from an analysis based on semiotics (Barthes, 1977, 2009; Chandler, 2017; Hodge & Kress, 1988; Williamson, 1978) in which we sought to interrogate the visual imagery being deployed in mass media public health interventions concerning antimicrobial stewardship. We use the term 'stewardship' here in line with extant use in this field (see Price *et al.*, 2018). The notion is etymologically derived from being a 'guardian' ('ward') of an essential resource, in this case antibiotics, within a One Health perspective where such guardianship must be shared by all stakeholders. The analysis has been designed to critically explore the

ideological apparatus underpinning antimicrobial stewardship interventions and explore how this may be related to effectiveness.

Theoretical context: affect and visual imagery

There is a growth of interest in affect within health psychology (DeSteno, Gross, & Kubzansky, 2013) and a long history of fear-based interventions in public health (Ruiter, Kessels, Peters, & Kok, 2014), in particular. Whilst there is growing interest in the role of emotion within health communications (Myrick, 2015), and many important new insights into emotions beyond threat alone (Dillard & Shen, 2018; Nabi, 2016), there remains a need for considerable further work that explicitly examines the place of emotion within health communications. This is an important area because there is good evidence that threat, for example, works to produce desired attitudes, intentions, and behaviours with few instances where interventions are not successful or have unintended consequences (Tannenbaum *et al.*, 2015). Analysis of multiple meta-analytic studies has shown how fear best operates when used to mobilize self-efficacy, and to some extent also response effectiveness, with threat designed to increase risk perceptions and fear arousal somewhat less effective (Ruiter *et al.*, 2014). However, beyond the specific domain of fear there remains a paucity of research on affect within the field (Myrick, 2015).

Affect is a term that is deployed in a variety of ways in the social and health sciences but is here being used as a way of referring to an embodied emotional response, along with a broader social notion that is beyond any individual feeling state. That is, whilst in much health psychology research affect is a collective term that refers to individual emotional responses and more generic moods (Myrick, 2015), we draw on sociological theory that recognizes the way that all individual embodied emotion states are themselves patterned by the social and material world (Fox, 2015; Wetherell, 2012). The approach taken herein therefore resists the tendency in some contemporary research to treat emotions as prior to or independent of ideology, as some sort of pre-determined biological apparatus separable from cognition. Our position instead employs the term affect to acknowledge the ideological patterning of emotion within health communications, which is amenable to an analysis that draws on semiotics (Barthes, 1977, 2009; Chandler, 2017; Hodge & Kress, 1988; Williamson, 1978).

A key element in extant fear arousal research, and potentially affect-focused work beyond fear, is the use of visual imagery as the means for communicating affect-laden messages (Noar, Hall, *et al.*, 2016). Much of the most sophisticated recent work on visual imagery has focused on smoking cessation (Cantrell *et al.*, 2013; Evans *et al.*, 2015; Kowitt *et al.*, 2017; Noar, Francis, *et al.*, 2016; Noar, Hall, *et al.*, 2016; Volchan *et al.*, 2013). Meta-analytic findings in this behavioural domain have demonstrated that pictorial warnings are more effective than text alone (Noar, Hall, *et al.*, 2016). Specifically, imagery was reported to have '(1) attracted and held attention better; (2) garnered stronger cognitive and emotional reactions; (3) elicited more negative pack attitudes and negative smoking attitudes; and (4) more effectively increased intentions to not start smoking and to quit smoking' (Noar, Hall, *et al.*, 2016: 341). In spite of this apparent effectiveness for the use of visual imagery in effecting behavioural change, there remains a lack of theoretical and empirical work on the mechanisms by which image-based warnings exert their effects or how affect might be best operationalized in mass media public health interventions, in general, and for antimicrobial stewardship in particular.

We suggest that the development of effective public health interventions necessitates understanding of the way that we might use visual materials to 'encode' (Hall, 1980) affect

such that people are sufficiently engaged with the message we are seeking to communicate. That is, if we wish to maximize the possibility of engagement with health messages, and ultimately aim to effect behavioural change, it is important to understand the ways that people might be emotionally affected (or not) and potentially mobilized into action by public health interventions (Tannenbaum *et al.*, 2015). This must also mean that we move beyond the tendency to focus on fear alone and explore the value of other affects, whether this is by exploring whether other affects are tacitly at stake within fear appeals (e.g., disgust) or through a focus on entirely distinct new domains of affect. Further, we argue that any analysis of affect within health communications must include an analysis of the grammar of the visual image, which includes consideration of meaning beyond the literal, and it is here where we believe semiotics can be of particular value.

Systematic review

The review used to generate the visual materials for analysis was prospectively registered on the PROSPERO international prospective register of systematic reviews (PROSPERO 2016: CRD42016050343) and was reported in accordance with the Preferred Reporting Items for the Systematic Reviews and Meta-Analyses statement (Moher, Liberati, Tetzlaff, Altman, & Group, 2009).

CINAHL, Cochrane Library, EMBASE, MEDLINE, and PsychINFO databases were searched for articles published between 2000 and 2016 using keywords associated with the following concept areas: the population – general public; the intervention – designed to increase antimicrobial awareness and/or to improve antimicrobial stewardship behaviour; the context – AMR or antimicrobial stewardship; the outcomes – all relevant short-, medium-, or long-term outcomes related to AMR and/or antimicrobial stewardship behaviours (knowledge/awareness, learning, public behavioural, and cognition outcomes). Cochrane’s Effective Practice and Organization of Care (Cochrane Effective Practice and Organisation of Care [EPOC], 2017) recommendations were used to select studies for inclusion in the review, with the addition of non-controlled before and after studies and prospective cohort studies due to the limited number of studies meeting the EPOC recommendations. This resulted in 20 studies included in the review (see Table 1), with the authors of 11 studies providing materials, three reporting the materials were no longer available and six offering no reply. For full details of this process see Price *et al.*, 2018. Whilst there is no minimum sample size for a semiotic analysis, this resulted in a large and varied body of visual materials for analysis including websites, teaching and interactive materials, posters and leaflets.

As shown in Table 1, the studies included randomized controlled trials ($n = 2$), non-randomized controlled trials ($n = 3$), controlled before–after studies ($n = 4$), non-controlled before–after studies ($n = 10$), and a prospective cohort study ($n = 1$). The majority of studies were conducted in the United States ($n = 8$) or in the United Kingdom ($n = 5$). The remaining studies were conducted in Italy, Portugal, Poland, Moldova, New Zealand, and Australia, while one study was a multisite study conducted in the United Kingdom, Czech Republic, and France.

Methodology for affective analysis

All available visual materials from the interventions, along with descriptions of these studies, from 12 of the 19 studies were systematically analysed for their affective

Table 1. Description of studies

Study	Design	Sample	Nature of intervention(s)	Outcome measures
Azevedo <i>et al.</i> (2013) Braga, Portugal	NCBA	N = 82 school children	School-based presentation followed by discussion	Knowledge and attitudes
Cebotarenco and Bush (2008) Chisinau, Moldova	CBA	N = 3,586 school children N = 2,716 parents	Educational intervention about the use of antibiotics delivered by student volunteers trained as peer leaders delivered to their classmates and the classmates' parents	Beliefs and behaviour
Croft <i>et al.</i> (2007) Wisconsin, USA	RCT	N = 300 parents	Distribution of printed materials to parents by child care staff; slide presentation delivered to staff	Knowledge
Curry <i>et al.</i> (2006) Auckland, New Zealand	NCBA	N = 400 general public	National campaign 'Wise use of antibiotics'. Posters and leaflets delivered to the public attending pharmacies E-Bug web game	Knowledge and attitudes and behaviour
Farrell <i>et al.</i> (2011) Glasgow, Gloucester, and London, UK	NCBA	N = 1,736 children		Knowledge and attitudes
Fornoso <i>et al.</i> (2013) Emilia-Romagna, Italy	NRT	N = 1,200 general public	Local mass media campaign (posters, brochures, and advertisements on local media) delivered to general population to raise awareness of inappropriate use of antibiotics	Knowledge
Gonzales <i>et al.</i> (2008) Colorado, USA	NRT	N = 1,503 general public	Mass media intervention (outdoor and radio advertisements) delivered to general public about use of antibiotics	Behaviour
Huang <i>et al.</i> (2007) Massachusetts, USA	RCT	N = 3,142 parents	Community-based educational intervention occurred through three successive cold and flu seasons.	Knowledge and attitudes

Continued

Table 1. (Continued)

Study	Design	Sample	Nature of intervention(s)	Outcome measures
Larson et al. (2009) Upper Manhattan, USA	NCBA	N = 422 households	Printed materials: (mailed newsletters, posters, pamphlets, and fact sheets in the waiting rooms of local paediatric providers, pharmacies, and child care centres) Targeted Latino households. Educational materials (colouring book, pamphlets) based on knowledge, attitudes, and practices regarding prevention and treatment of upper respiratory tract infections. Programme was delivered during home visits every 2 months	Knowledge & attitudes and behaviour
Lecky et al. (2010) Gloucestershire and London, England; Nice and Bordeaux, France; Prague and Ostrava, Czech Republic	CBA	N = 2,724 school students	School-based educational intervention (e-bug) regarding inappropriate antibiotic use delivered to classes of 9- to 11-year-old (junior) & 12- to 15-year-old (senior) students in state schools. Included 45-min lesson handouts, worksheets, factsheets, interactive activity and a follow-up plenary question-and-answer session	Knowledge
Madle et al. (2004) London, UK	NCBA	N = 177 general public	Open access to the National electronic Library of Infection Antimicrobial Resistance website on the use of antibiotics and antibiotic resistance. The site comprises frequently asked questions and links to evidence-based resources	Knowledge & attitudes

Continued

Table 1. (Continued)

Study	Design	Sample	Nature of intervention(s)	Outcome measures
Mainous <i>et al.</i> (2009) South Carolina, USA	Prospective cohort study	N = 691 Self-identified Latinos	Mass media educational intervention (pamphlets, radio, newspapers) delivered to local Latino communities about use of antibiotics	Behaviour
Mazinska and Hryniewicz (2010) Poland	NCBA	N = 1,000 general public	Mass media educational intervention (posters, leaflets, billboards, TV, cinemas, radio, press, magazines, thematic exhibitions, Internet) implemented across the country	Knowledge, attitudes and behaviour
McNulty <i>et al.</i> (2001) Gloucester, UK	NCBA	N = 38 year 5 school children	School-based intervention to children aged 9–10 years at a state school. Included two 90-min interactive workshops entitled 'Antibiotics and your good bugs'	Knowledge
McNulty <i>et al.</i> (2007) Gloucestershire, UK	NCBA	N = 198 year 5 and 6 school children	School-based intervention. 'Bug Investigators' pack about micro-organisms, hygiene, and antibiotics The pack included 11 activity sheets, teachers' guide, poster, and website	Knowledge
McNulty <i>et al.</i> (2010) England and Scotland, UK	CBA	N = 3,718 general public	Mass media campaign about antibiotic use involving posters displayed in magazines and newspapers	Knowledge and attitudes and behaviour
Pontes and Pontes (2005) Mid-Atlantic region, USA	NRT	N = 105 university students	University-based educational intervention (information booklet) to increase young adult consumers' preference for physicians who do not unnecessarily prescribe antibiotics for simple acute upper respiratory tract infections	Attitudes

Continued

Table 1. (Continued)

Study	Design	Sample	Nature of intervention(s)	Outcome measures
Stockwell et al. (2010) New York City, USA	NCBA	N = 10 parents	Health literacy intervention regarding upper respiratory tract infection delivered to parents on a 'Early Head start' programme. Involved 3 × 1.5 hr interactive sessions and provision of kit for care of a child with such an infection	Knowledge and attitudes and behaviour
Trepka et al. (2001) Northern Wisconsin, USA	CBA	N = 365 parents	Nurse educators delivered parent-oriented presentations in community organizations, distributed information pamphlets, and displayed posters. Topics covered included antibiotic resistance and use	Knowledge and attitudes and behaviour
Wutzke et al. (2006) Australia	NCBA	N = 6,217 general public	National mass media intervention for consumers delivered during winter months in 2001, 2002, 2003, and 2004. About the inappropriate use of antibiotics for upper respiratory tract infection. Strategies included newsletters and brochures, mass media activity using billboards, television, radio and magazines, and small grants to promote local community education	Knowledge and attitudes and behaviour

components. No ‘off-the-shelf’ methodology is available within health psychology for analysing this kind of material and so we developed a method by drawing on semiotics (see Chandler, 2017), notably the work of Barthes (1977, 2009), with a particular focus on affect. There is considerable disagreement within the field of semiotics about the scope of the discipline but fundamentally it is concerned with the study of signs (Chandler, 2017), and to this end, there has been the development of a sophisticated theoretical toolkit for critically examining the meaning of textual and visual materials beyond the literal. We draw on a limited number of concepts, primarily from the work of Roland Barthes (1977, 2009), which are described below, in a pragmatic attempt to interrogate visual materials concerned with antibiotic stewardship. It is important to note that this is not a piece of semiotic analysis *per se* but rather an attempt within health psychology to utilize a number of particularly useful concepts and tools from semiotics in order to critically examine the affective elements within a set of visual materials.

Central to the analysis described in this article is an examination of denotation, connotation, and ideology. Denotation refers to the literal relationship between the signifier and signified, the ‘dictionary definition’ or most culturally shared meaning (Chandler, 2017). Connotation refers to wider socio-cultural associations inflected by ideology and emotion, and which are related to the interpreter’s age, class, culture, and so on (Chandler, 2017). Importantly, Barthes (1974/1990) points out that whilst denotation appears to be the primary meaning (‘the superior myth’), this is an illusion as it is rather simply a connotation that has become ‘naturalized’. That is, we share a cultural understanding whereby the denotative meaning is perceived to be untainted by ideology, when in fact it is the process of learning dominant connotations (denotations) that positions us all within ideology (Althusser, 1972). Ideology is being used here as akin to the notion of ‘myth’ (Barthes, 1977), which is effectively an extended metaphor in which the cultural underpinnings of a sign are naturalized. This is the taken-for-granted (or common sense) meaning that underpins a sign – the set of beliefs commonly shared by a group of people (Van Dijk, 1998) – and that is necessary for everyday discourse but that must be subject to a deconstructive analysis if we are to understand the ideological layers at play in any form of communicative practice.

The analytic process involved a particular focus on visual imagery (including the use of colour where appropriate) and how images deployed in intervention materials encode affect within broader social systems of meaning. We focus on visual imagery because it is a primary site for evoking emotion, rather than communicating complex information, where the written or spoken word is generally more effective (Leavy, 2015). Understanding the way that visual stimuli might serve to facilitate engagement and behaviour change in ways which amplify, moderate, or side-step cognition is critical if we are to engage members of the public, health professionals, and others with antimicrobial stewardship interventions. With this in mind, it is as important to evaluate the affective impact as much as the effectiveness of any health intervention designed to change awareness and increase antimicrobial stewardship amongst the public.

None of the interventions that have been analysed in this study have referred to emotion or affect as explicit elements within their theoretical framework but they invariably relied on modes of affect to convey meaning, nuance it, and engage audiences. The analysis conducted herein highlights the importance of affect across the range of antimicrobial stewardship interventions analysed and the need for explicit awareness of this important component and how it might be used to best effect in communications with the recipients of public health interventions.

Method

Intervention descriptions and materials were extracted and tabulated for analysis. Available visual intervention materials were collated for analysis and analysed by DL with the entire analysis audited and confirmed by an additional two researchers (PF and MD). All materials were examined for the ways that they used visual imagery to evoke affect but with the focus primarily on the 12 packs of intervention materials that were made available. This included analysis of text where appropriate and particularly where it served to work together with visual images to construct coherent communicative visual meaning units. The analytic procedure was, as follows:

1. All visual materials were extracted and collated. This process also included the collation of all textual material that related to visual and/or affective components. The criteria for inclusion were kept as broad as possible at this stage to ensure inclusion of all material of whatever kind that might be used for the encoding of affect.
2. The collated intervention imagery and text were then examined for affect drawing on principles from semiotics (Barthes, 1977, 2009; Chandler, 2017; Hodge & Kress, 1988; Williamson, 1978). The first pass involved note taking of any explicit (literal) mentions of affect (examination of denotation). The second pass involved note taking of implicit cultural meanings (examination of connotation), value judgements, and associations. The connotative level was further examined for signs that are metonymic (representing something else, e.g., child as image of future) and synecdochal (where a part of something refers to a whole of something else, e.g., a pill representing an illness).
3. The third stage sought to deepen the connotative analysis and involved a critical examination of ideology. This involves identification of the particular ideological positions being brought into play by the visual imagery and text in order to grasp the social effects of meaning in the material being deployed. Following the work of Bal and Bryson (1991) and Barthes (1977, 2009), this stage involved an analysis exploring how the implicit ideological apparatus might serve to emotionally engage audiences (or not) by deploying a form of emotional power (e.g., through identification).
4. The final stage was to draw together key concepts and ideas through a thematic analysis of the array of analytic material in which information from the above stages was brought together into coherent themes. This thematic analysis provides a summary of the analysis and is used to clearly and simply illustrate the results below.

The identification of connotation and ideology is something that is not easily described or formalized. It has the quality of ‘I know it when I see it’ (Van Dijk, 1998) because an analysis of connotation and ideology is, in large part, an analysis of one’s own culture in relation to the material being subject to analysis. It requires a critical stance not only towards the materials being analysed but also one’s own subjectivity, a ‘critique of the illusions of the subject’ – ‘distanciation of self from itself’ – in Ricoeur’s (1970) terms (see Langdrige, 2007). There are practical clues to the identification of ideology, such as the use of discourse involving ‘us versus them’ or ‘ingroup versus outgroup’ membership (Van Dijk, 1998), but ultimately any quality judgement must be determined on the basis of producing an account that is persuasive to one’s peers. That is, any analysis of this kind must be something that can be subject to juridical account by an informed audience through an open and auditable process (Ricoeur, 1970, 1976, 1981).

Findings

Tacit versus explicit affect

The most striking finding from the analysis is how affect could be identified as a factor within all of the 20 intervention descriptions, but was rarely explicitly formulated or reported. Only one of the 20 studies reported to have sought affective response in audiences (or emotional engagement in any form) as a means of creating more engaging intervention materials or evaluated the affective impact of their intervention materials on their respective audiences. The one exception was research by Farrell *et al.* (2011), which evaluated the E-Bug Detective Game. Even here, however, analysis of affect was minimal as it was only considered in the context of creating an engaging, enjoyable game in the mode of 'edutainment'.

The lack of explicit consideration of affect was noticeable even when researchers were otherwise engaging with the socio-cultural elements of audience receptivity to an antimicrobial stewardship intervention. For instance, in Mainous, Diaz, and Carnemolla (2009), the authors explicitly sought to recognize the way that Latino communities in South Carolina, USA, often bypass medical providers of antibiotics and instead obtain medication informally through other members of their communities. Whilst the intervention sought to be culturally sensitive, there was no explicit attempt to either understand the affective motivation for such behaviours or deploy messages within a specific affect-laden cultural context. Similarly, the study discussed in Gonzales *et al.* (2008) sought to consider the implications of translation when communicating a message in Spanish rather than English and how the intervention slogan needed to be changed. This was an ideal opportunity to also consider cultural differences in affect and how messages might be affectively tailored to specific communities but was not considered/ reported.

Thirteen out of the 20 studies were concerned with attempts to increase knowledge through – mostly – didactic education interventions (Azevedo, Pinheiro, Yaphe, & Baltazar, 2013; Cebotarenco & Bush, 2008; Croft *et al.*, 2007; Farrell *et al.*, 2011; Huang *et al.*, 2007; Larson, Ferng, McLoughlin, Wang, & Morse, 2009; Lecky *et al.*, 2010; McNulty, Bowen, Gelb, & Charlett, 2007; McNulty, Nichols, Boyle, Woodhead, & Davey, 2010; McNulty, Swan, & Boland, 2001; Pontes & Pontes, 2005; Stockwell *et al.*, 2010; Trepka, Belongia, Chyou, Davis, & Schwartz, 2001), very often with schoolchildren or parents. These studies used a variety of means for increasing knowledge about antibiotics and antimicrobial stewardship more generally. These included teacher-led lessons, the use of interactive learning and computer games with children, health literacy campaigns, and health care professional-led presentations for adults. Across all of these interventions, there was minimal discussion of the need to engage an audience via content or delivery mechanism nor any discussion of the possible power of affect to help effect attitudinal and/or behavioural change. McNulty *et al.* (2001) refer to the use of 'colourful slides' in the educational presentation and engagement from the audience but still there is no explicit theorization or active deployment of affect as a means of enhancing learning or effecting attitudinal or behavioural change. Similarly, Azevedo *et al.* (2013) describe a slide show and discussion intervention for 9th Grade children, most of which is didactic biology education but which shifts in affective tone markedly when discussing antibiotic stewardship with the sudden appearance of cartoon character bugs, and antibiotics as superheroes.

Affective themes and ideological apparatus

Below three thematic categories of affect are discussed in terms of their denotative and connotative meaning and ideological affects as deployed in the intervention materials available to us. These three themes were relevant to the majority of the intervention strategies that we examined.

Theme 1: Monsters, bugs, and superheroes

Visual imagery of monsters, bugs, and superheroes was deployed in six interventions (Azevedo et al., 2013; Farrell et al., 2011; Lecky et al., 2010; Madle, Kostkova, Mani-Saada, Weinberg, & Williams, 2004; McNulty et al., 2007, 2010), with some recycling materials (mostly from Bug Investigators, e-Bug Teaching Pack) or using similar imagery. Many of these interventions were designed for children, though not all. A common trope was the use of cartoon-like monsters to represent bacteria and viruses. They demonstrated varying levels of affect, with some clearly threatening (e.g., showing barred teeth and claws) and others much less so (e.g., showing a smile or non-threatening facial expression). Bright colours and jelly-like appearance tended to soften the sense of threat and malevolence, especially through the use of ‘mood enhancing’ saturated reds and yellows and avoidance of ‘unpleasant’ brown and black colours (Simmons, 2011), even amongst those designed to be most threatening. And whilst some images did deploy images of viruses with barred teeth in a dirty green colour, they also added comic eyebrows or hair (see Figure 1), which is likely to lessen any sense of threat. Azevedo et al.’s study (2013) is worth noting for the use of a particularly malevolent image of a devil stirring a cauldron in a presentation for 9th Grade school children in Portugal, which may be culturally specific.

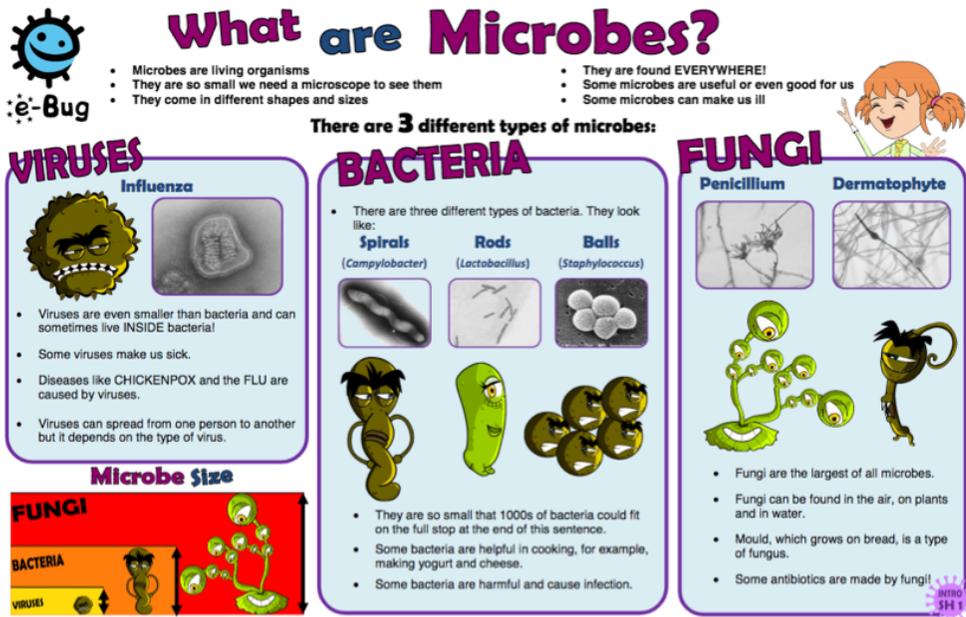


Figure 1. Page image from e-bug teaching pack (www.e-Bug.eu).

The affective counterpoint to threat from monsters and bugs in many of these interventions came in the form of an image of an anthropomorphic antibiotic pill. In one set of materials, this kind of image came in the form of a male looking ‘Andybiotic’, whilst in others a very similar image is non-gendered but configured with a superhero like cape. Andybiotic is somewhat inconsistent in terms of affect for he is portrayed teacher-like (wagging finger and crossing arms in an admonishing way) and yet also in need of protection (expressed via the warning slogan ‘Don’t wear me out’). Similarly, the superhero version is affectively ambiguous being both endowed with super powers, thus offering the possibility of protector of life, and yet also as fragile and in need of human protection. The image of Andybiotic is connected with a long-standing culture of the ‘magic bullet’ associated with the invention of drugs which combat scourge-like infections and ideas of scientific control of the natural world and human progress (Bud, 2007).

The gendering of Andybiotic brings considerable ideological machinery into play (Hall, 1980) in the form of supposed masculine dominance of nature (Steinberg, 1993) and limiting the possibility for universal identification amongst the gender mixed audience (Lawrence & Jewett, 2002). Identification with imagery is critical for affective engagement, with character identification a particularly powerful representational process (Baudry, 1970/2011; Metz, 1977/1982). Key here though is the need for ‘homophily’ (similarity) between character and viewer (Andersen & Todd de Mancillas, 1978), with appropriate representations of diversity (gender, ethnicity, etc.) critically important for identification to occur (Langdrige, Gabb, & Lawson, forthcoming).

Theme 2: Responsibility, threat, and the misuse/abuse of antibiotics

Various images were deployed to encode responsible stewardship, often mobilized through a sense of threat (Formoso *et al.*, 2013; McNulty *et al.*, 2010; Pontes & Pontes,

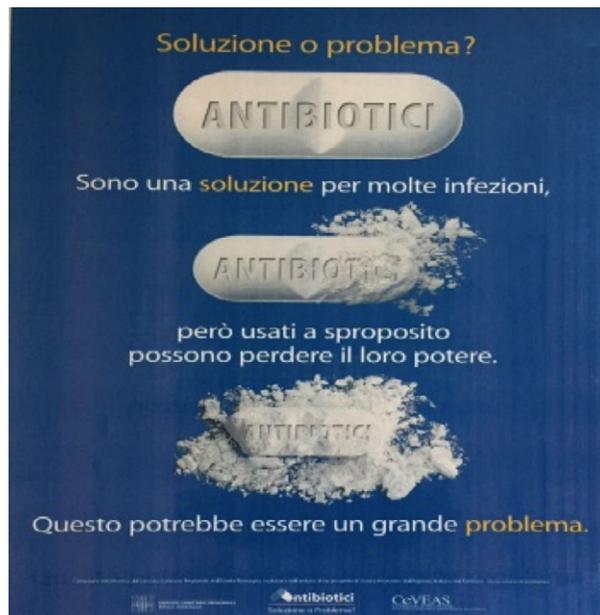


Figure 2. Image from Formoso *et al.* (2013).

2005; Wutzke *et al.*, 2006; Stockwell *et al.*, 2010). This includes very simple signs of threat such as Pontes and Pontes (2005) and the Centers for Disease Control and Prevention leaflet that uses capitalization to invoke threat in the form of the word 'WARNING' at the top of the leaflet or the use of selective red wording in the Stockwell *et al.* (2010) intervention to connote warning and predicate the words and images beneath. The Northern Italian public health intervention described in Formoso *et al.* (2013) eschews warning signs with a sequence of still images of a fragmenting antibiotic pill (see Figure 2). This image is loaded with ideological meanings of the destruction of a fragile resource as opposed to threat to the audience. The message encoded in this imagery may, however, be read in other ways since pills are sometimes designed to dissolve, as in some forms of analgesia. The possible multiple readings of some images are another reason for closer attention to the use of visual codes and related affective and ideological effects in intervention design.

Perhaps most significant in this affective category is Wutzke *et al.* (2006) and the associated Australian mass media intervention, which is also discussed further below with regard to the use of images of children. The materials relating to the article had not been provided at the time of writing but the intervention is run on an annual basis and the most recent materials can be found on their website (2016/17 at the time of writing) and so formed the basis for this analysis. Two posters in this intervention feature adults (one older man, the other a younger woman) holding the message 'Are you an antibiotic misuser? Misusing antibiotics can cause harm' and another featuring a young man holding the message 'Antibiotic resistant bacteria: you could be passing it on'. The first two speak to the ideological notion of drug misuse (more commonly understood affectively amongst the public as 'abuse'), with the potential to evoke a sense of (moral) disgust (shame and guilt) or at the very least disapproval through a normative trope, which is potentially problematic. The third poster evokes a similar sense of moral disapproval and the invocation of personal responsibility with echoes of 1980s interventions on human immunodeficiency virus and earlier ones on sexually transmitted infections.

Theme 3: The figure of the child

Figural images of children featured centrally in two studies (Gonzales *et al.*, 2008; Wutzke *et al.*, 2006) as a powerful means of mobilizing affect. The imagery in these two studies is striking with images of (beautiful) children looking up and out of the photographs, with their gaze direct to camera designed to engage the viewer with a sense of personal responsibility for future generations, interpellating us (Althusser, 1972) with a drive to steward antibiotics for them. The Australian intervention featured in Wutzke *et al.* (2006) associates the image of a young girl (who is not smiling but staring direct through the camera lens) with the slogan 'Handle with care', speaking to the caring ideology of parenthood and generational responsibility.

The mass media intervention described in Gonzales *et al.* (2008) based in Colorado, USA, is even more striking in the way it seeks to evoke affect. The posters that were placed on billboards and the back of buses, and were central to this intervention, featured children and slogans that are arguably the most emotive of all the interventions discussed in this report. One features a young boy stripped to the waist (emphasizing his pre-pubertal vulnerability) with his arms up as if showing his biceps like dad, and as a means of emphasizing his vitality (see Figure 3). Against

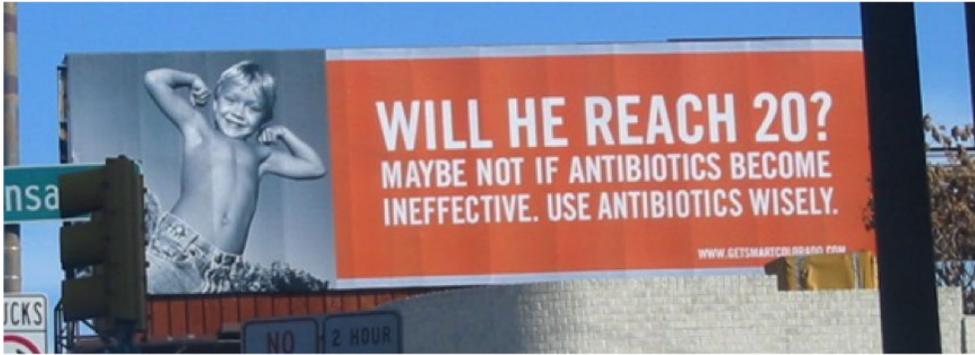


Figure 3. Poster from Gonzales *et al.* (2008). The Get Smart Colorado intervention was supported by a grant from the Agency for Healthcare Research and Quality.

this striking idealized image of childhood is the slogan, ‘Will he reach 20? Maybe not if antibiotics become ineffective’. The other poster features a close-up image of a baby’s face looking up and out of the image set against the slogan ‘Hospitalized at 8 because antibiotics became ineffective’. Parenthood and ‘the family’ are powerfully signified to evoke affect amongst viewers for whom this is meaningful imagery. This ideological apparatus powerfully demands that present-day desires to use antibiotics must be subordinated to protect innocent children.

Effectiveness and affect

The visual image analysis we conducted was dependent on access to the intervention materials and as such is limited by not having the intervention materials for all studies. It is also important to note that no conclusive associations can be made regarding relationships between affect and effectiveness, only tentative suggestions. Notwithstanding, across the available intervention materials some patterns can be identified that may warrant further examination. There is some evidence for interventions in which there has been a concerted effort to engage the target audience to be more effective in terms of effecting behavioural change. Equally, with regard to the specific affective content that was available, there is some, at this stage, necessarily tentative, support for the idea that those interventions which elicited affect through the figural image of the child were more likely to be effective.

Of those six studies with the strongest effect (clear behaviour change in the outcome measure), there were three that did not provide detail of the intervention and so could not be included in the affective analysis. Of the remaining three studies (Gonzales *et al.*, 2008; Stockwell *et al.*, 2010; Wutzke *et al.*, 2006), two employed the most affectively powerful material in this analysis (within the context of mass media interventions), with a strong focus on the image of the child as the means to generate a sense of future-focused responsibility for antibiotic stewardship. The third study (Stockwell *et al.*, 2010) did not apparently employ strongly affective visual materials and was much more informational in content but it was also of a very different scale to the first two studies and involved close interpersonal contact between the intervention providers and the recipients. It is highly likely that this very personal communicative setting (small seminar groups) would in itself

have provided a framework for affect being deployed as a motivational driver for behavioural change. A seventh study (Cebotarenco & Bush, 2008) showed some evidence of desired behavioural change but we did not have the intervention materials. Description of these materials does, however, indicate they are likely to have had an affective component.

Two studies reported negative effects (Formoso *et al.*, 2013; Mainous *et al.*, 2009), with two others no positive effect at all (Farrell *et al.*, 2011; McNulty *et al.*, 2010). The intervention materials were not available for analysis for Mainous *et al.* (2009) but Formoso *et al.*'s study (2013) is notable for the possibly confusing imagery of the fragmenting pill. Given this image is commonly understood within the similar but different context of advertising of soluble pills, it is potentially problematic for the viewer. The accompanying text was neutral with little attempt to use affect to engage the viewer. Farrell *et al.*'s study (2011) is unusual in that it concerns a computer game that implicitly attempts to communicate messages about antimicrobial stewardship with the primary outcome learning gain. Behavioural intention may have been a better outcome measure but regardless, the only attempt to utilize affect was as a means of ensuring game playability. McNulty *et al.* (2010) use 'traditional' generic health imagery to engage the viewer (e.g., get well balloons), none of which is likely to have much affective power given their familiarity within a broad medical context or directly engage the viewer to the particular issue of antimicrobial stewardship.

Discussion

This analysis has shown how affect is a present but tacit communication strategy of antimicrobial stewardship interventions but has not – to date – been adequately theorized or explicitly considered in the intervention design process. The use of imagery, colour, typesetting, and other signs connoting threat, fear, and other affects, such as disgust, are all differently deployed by intervention designers in an effort to engage the recipient such that they gain new knowledge or change their antibiotic use behaviour. However, there is a lack of consistency or theoretical justification for the choices being made. Given the extensive research on threat and fear arousal (see Tannenbaum *et al.*, 2015) and its employment in smoking cessation interventions, it is noteworthy that this affect alone has not been given more prominence in the materials. That is, whilst it was implicitly used in some studies, there was no explicit attempt made to engage fear in the intervention materials. To some extent, the same might be said for the inconsistency around the use of visual imagery and colour choice, where there is good evidence for improved efficacy where imagery and colour are appropriately used in health and other communications (Aslam, 2006; Elliot, 2015; Elliot & Maier, 2014; Noar, Hall, *et al.*, 2016).

Whilst there is still relatively limited understanding of the processes underlying communication of affect in health behaviour change interventions, the choices around imagery and colour made in the studies examined herein were not underpinned by the extant empirical research that is currently available. Nor were decisions about particular choices informed by theoretical arguments in the literatures on affect, visual imagery, or colour receptivity. This not only results in interventions that might be less effective but in some instances it might actually lead to disengagement amongst the group targeted by the intervention. For example, the use of the colour red as a signifier of danger or threat would work well in Anglo-Saxon and Germanic cultural contexts but not in a Chinese cultural context, where red signifies love, happiness, and luck (Aslam, 2006). The studies by

Pontes and Pontes (2005) and Stockwell *et al.* (2010) both appropriately use the colour red to alert the recipient to the sense of threat being communicated in their textual material and were largely effective. In contrast, the intervention reported by Formoso *et al.* (2013) that was largely ineffective relied on imagery (the fragmenting pill motif) that is perhaps too ambiguous or abstract to evoke fear or any sense of threat or even particularly engage the viewer, though we recognize that the image may not have been designed to encode affect at all. This intervention also adopted a pale blue colour palette that may or may not be useful depending on the nature of the aims of the programme. Blue is traditionally associated with quality and being trustworthy across most cultures so may act as a cue to trust the content but will not necessarily alert or arouse the recipient (and thus engage them to read) or most crucially cue a sense of fear or threat (Aslam, 2006).

We have also demonstrated ideological apparatuses at play in these health intervention materials: gender and the scientific mastery of nature; the figural image of the vulnerable child. The visual imagery of monsters, bugs, and superheroes was deployed in a large number of interventions (Azevedo *et al.*, 2013; Farrell *et al.*, 2011; Lecky *et al.*, 2010; Madle *et al.*, 2004; McNulty *et al.*, 2007, 2010). Furthermore, a number of studies used the same set of cartoon-like characters based on the heroic – and male – figure of ‘Andybiotic’ to engage and mobilize the intervention recipients. This narrative – character-driven – model of information presentation may engage audiences, although this is still based on an assumption about monsters and bugs being intrinsically appealing to children, with what might otherwise appear rather dull factual material about antimicrobial stewardship (Igartua & Barrios, 2012). However, this is not without some risk in this instance due to the gendered nature of the particular images in question. Given the evidence in support of identification as a primary route to engagement with media (Igartua & Barrios, 2012; Igartua & Vega Casanova, 2016; Murphy, Frank, Chatterjee, & Baezconde-Garbanati, 2013), it is critical for intervention materials to provide characters that are open to identification by all viewers. Gender bias in the images superheroes, alongside the explicitly male central character of ‘Andybiotic’, risks closing down identification amongst girls and women due to the lack of ‘homophily’ (similarity) with the media character (Andersen & Todd de Mancillas, 1978) and replays other assumptions concerning gender, science, and nature.

The figural image of the child was used as a way to interpellate the responsible individual in antimicrobial stewardship behaviour in two studies (Gonzales *et al.*, 2008; Wutzke *et al.*, 2006). Both interventions also reported some effectiveness in achieving their desired outcomes with regard to increased knowledge and behaviour change, although we must be careful not to overinterpret this relationship. The authors in these studies used a culturally powerful ideology of the protection of the child and the need to act to protect their future, at an individual and collective level. The danger of such ideologically loaded images like these is that they mobilize blame such that the failure to use antibiotics responsibly is akin to failing to act to protect children. The use of images like these may lead to the demonization of those found to be infected with drug-resistant bacteria.

It is, of course, important to acknowledge the limitations of this study. Most importantly, while we have sought to explore the relationship between affect within intervention materials and the effectiveness of the interventions, we cannot draw any serious conclusions about the relationship between affect and effectiveness. The interventions differ in numerous ways, notably in this instance with different visual materials being used (e.g., posters, workshops, interactive materials, and games) and that might be subject to an analysis. Reflections on effectiveness should instead be seen as

providing insights for further investigation and testing. The study was also limited by having access to a limited array of intervention materials. This somewhat limits our ability to look at patterns and associations but is a valuable reminder of the continuing need to encourage good practice in data storage and sharing within health psychology.

It is also worth reflecting on the fact that this is also the first presentation of a novel form of analysis, a method that is currently limited to just one behavioural domain. It is vital that the method is tested with other health intervention materials and also potentially developed further to provide a more routine tool for use within systematic reviews and/or a method for the analysis of affect and ideology more broadly within health psychology. The method in its current form is demanding and requires skill and practice to be deployed effectively. That is, this is not an approach that can be easily or simply codified but instead relies, in part, on the ability of the analyst to critically interrogate the visual materials, alongside their own worldview. This necessarily involves moments of embodied reflexivity in order to grasp the affective content and power of the materials being analysed, and the analyst needs to be able and prepared to do this. A therapeutic sensibility is also helpful, although it is not necessary to be a therapist, for the ways that it encourages a person to tune in to their embodied experience, their own 'felt-sense' (Gendlin, 2003) or countertransference (Stefana, 2017).

As we have noted, the ways in which affect is denoted, connoted, and ideologically loaded is a ubiquitous, vital but tacit element of communication on antimicrobial stewardship. The studies we have analysed used affect to engage audiences, but not in a knowing, reflective way. They have, however, provided us with a rich source of possible directions in intervention design and as our analysis indicates place antimicrobial stewardship communications on a threshold of evidence-based development. As we have suggested, the field can draw on existing evidence of the effectiveness of affective communication to supply a basis for the choices of affective codes. Most importantly, affect needs to be foregrounded in intervention design and evaluation for the field to progress and for antimicrobial stewardship communications to be successful.

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Conflict of interest

All authors declare no conflict of interest.

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