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Assessing the expectations associated with pharmaceutical pill colour and shape

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ABSTRACT

Two experiments are reported in which people's sensory, hedonic, and efficacy expectations associated with pharmaceutical pills of differing colour and shape were assessed. In Experiment 1, 101 participants from the USA viewed online photos of tablets having one of 7 colours and 3 shapes. The participants had to arrange the 21 tablets based on the expectations generated solely by the tablets' visual properties. The results revealed that the colour of the tablets influenced expected bitterness, expected alertness, and expected efficiency in combating headaches, whereas the shape of the tablets influenced the expected difficulty of swallowing. In Experiment 2, the major findings of Experiment 1 were replicated while using a greater variety of colours, in 358 participants from China, Colombia, and the USA. Importantly, the results revealed some shared expectations across cultures, such as the high expected efficacy of white tablets in combating headaches, or the high expected difficulty of swallowing the diamond-shaped tablets. The results also revealed some differences among the three groups, such as that the colour of the pills influenced how difficult the Chinese participants (but not the other two groups) expected the pills would be to swallow. These findings clearly demonstrate that the differing colours and shapes of pharmaceutical pills set-up significantly different expectations which likely play an important role in terms of people's subsequent experience.

1. Introduction

Colour exerts an important influence on our perception and behaviour (see Elliott & Maier, 2014, for a review), including prompting consumer expectations (e.g., Labrecque, Patrick, & Milne, 2013; Shankar, Levitan, & Spence, 2010; Spence, 2010; Velasco et al., 2014; Wan, Woods, et al., 2014; Wan, Woods, Seoul, Butcher, & Spence, 2015). These expectations can influence the very earliest stages of sensory information processing (Woods et al., 2011), and anchor people's subsequent product experiences (e.g., Deliza & MacFie, 1997; Piqueras-Fizman & Spence, 2015; Schifferstein, 2001; Yeomans, Chambers, Blumenthal, & Blake, 2008). For example, the expectation that a drink will be bitter can actually enhance its perceived bitterness (e.g., Olson & Dover, 1978).

An extensive body of research has shown that our taste/flavour perception can be changed by the colour of various foods and drinks (see Spence, Levitan, Shankar, & Zampini, 2010, for a review), product packaging colour (Roullet & Droulers, 2005; Spence & Piqueras-Fiszman, 2012; see also Esterl, 2011), and even the colour of the environment in which we happen to eat and drink (e.g., Oberfeld, Hecht, Allendorf, & Wickelmaier, 2009; Spence, Velasco, & Knöferle, 2014; Velasco, Jones, King, & Spence, 2013; see Spence & Piqueras-Fiszman, 2014, for a review).

Despite the fact that the field of medical research continues to make great progress in terms of the development on novel treatments for a variety of conditions, one continuing problem concerns the fact that many oral medicines can leave a very bitter and/or metallic taste in the patient's mouth (Lawless, Stevens, Chapman, & Kurtz, 2005). It has been suggested that the unpleasant oral properties associated with many medicines may, at least in part, contribute to the poor compliance rates that have been documented across a number of medicines over the years (e.g., Baguley, Lim, Bevan, Pallet, & Faust, 2012; Cram, Breitkreutz, Desset-Brèthes, Nunn, & Tuleu, 2009). Such an unpleasant taste

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can be particularly problematic when it comes to paediatric medications (Dagan, Shvartzman, & Liss, 1994; Iwai, 1997). Indeed, what is also worth bearing in mind here is that younger children may find such tastes especially unpleasant given their increased sensitivity to bitterness (e.g., Prescott, 2012; Spence, 2012).

Encapsulating bitter-tasting compounds so that they do not come into direct contact with the mouth works as a solution for certain medicines. However, tablets are cheaper to produce (Studzinski, 2004), and on occasion, the same drug may be preferred in tablet as compared to capsule form (e.g., Sims, 1986). Given such limitations in terms of drug delivery, researchers have become interested in the possibility of modulating a patient's sensory experience associated with taking oral medications (and their belief regarding the efficacy of the medication) by tailoring the expectations that arise (sometimes implicitly) from a variety of non-gustatory cues concerning the medicines. These cues include everything from branding and pricing (Babin, Hardesty, & Suter, 2003; Labrecque & Milne, 2011; Shiv, Carmon, & Ariely, 2005) through to the sound symbolic-meaning associated with the brand or drug name (Abel & Glinert, 2008; Dohle & Siegrist, 2014).

Another way in which to tackle the issue of the bitter sensation produced by a pill's taste could be to use the colour of the medications to set certain expectations in the mind of the consumer/patient (see Kuenzel, Zandstra, Deredy, Blanchette, & Thomas, 2011). Considering that previous marketing research has demonstrated that colour differentiation can help develop product category norms (e.g., Labrecque & Milne, 2012), it would seem reasonable to hypothesise that colour cues might also affect the expected ease/difficulty of swallowing, taste, and/or possible efficacy of medicines, such as their arousing/relaxing potential or their ability to relieve the symptoms of a headache, say.

Over the years, a number of studies have assessed whether changing the colour of the medication has a significant effect on efficacy (e.g., Lucchelli, Cattaneo, & Zattoni, 1978; Shapira, McClelland, Griffiths, & Newell, 1970; also see De Craen, Roos, de Vries, & Kleijnen, 1996, for a review). The typical finding that has emerged from much of the previous research is that changing the colour of a medicine can indeed influence perceived efficacy. For example, Sallis and Buckalew (1984) reported that people expected red and black capsules to be stronger, whereas white capsules were judged to be the weakest.

It is also important to note that the meaning of colour can sometimes change over time (Adams & Osgood, 1973; Hupka, Zaleski, Otto, & Tarabrina, 1997). As such, the possibility must be borne in mind that the results concerning the meaning of colour that were reported in a particular context (e.g., the medical field) in the 1970s and 80s, may no longer provide an accurate reflection of consumers' beliefs and expectations today (see also Elliot & Maier, 2012, for the contextual nature of colour). In particular, when a new medication comes on the market, people's expectations concerning the associations with particular colours in medicine may change. It is easy to imagine, for example, how the meaning of a diamond-shaped blue pill may have changed following the launch of Viagra back in 1998. It should also be noted that a number of studies have demonstrated significant cross-cultural differences in terms of the meaning of colour (Aslam, 2006; Courtney, 1986), in the context of both food and drink (Shankar et al., 2010; Velasco, Wan, et al., 2014; Wan, Velasco, et al., 2014; Wan et al., 2015) as well as medicine (e.g., Lucchelli et al., 1978). Therefore, the important point to note here is that the results that may be obtained from one cultural group at a given point in time need not necessarily apply to the same or other populations at a different point in time.

Aside from the fact that the shape, surface area, and diameter influence the release rates of a drug (Ford, Rubinstein, McCaul, Hogan, & Edgar, 1987; Gökçe, Özyazıcı, & Ertan, 2009), the shape of medicines can also communicate higher-order information to the consumer/patient (e.g., see Hussain, 1972). Numerous studies have shown that rounder shapes are preferred over angular shapes in various contexts (Bar & Neta, 2006, 2007; Silvia & Barona, 2009; Westerman et al., 2012). Moreover, people tend to associate round shapes with sweetness (Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014; Velasco, Woods, Deroy, & Spence, 2015; Wan, Woods, et al., 2014). Separately, the expectation that a food and/or drink will taste sweet or are pleasant, can increase subsequent liking of such food or drink (Kuenzel et al., 2011).

The present study was conducted in order to explore the influence of the colour and shape of tablets on people's expectations. Part of our purpose was to provide an accurate reflection of consumers' beliefs and expectations at the present point in time (given that the meaning of pill colour and form has, at least in certain circumstances, changed over the decades). We also chose to test participants from three different countries (the USA, China, and Colombia), in order to provide some preliminary evidence and initial groundwork for future cross-cultural research. We used the same online survey approach that had been used previously to examine the taste/flavour expectations concerning beverage and packaging colours (Velasco, Wan, et al., 2014; Wan, Velasco, et al., 2014; Wan et al., 2015). Pictures of tablets in a variety of colours and shapes were presented to participants who were quizzed about their expectations on the taste and efficacy of the pills.

2. Experiment 1

2.1. Methods

2.1.1. Participants

One hundred and one participants (mean age = 32.8 years, SD = 11.8, ranging from 19 to 64 years; 40 female) recruited from Amazon's Mechanical Turk took part in this experiment in exchange for a payment of 0.80 US dollars. Through a feature of Mechanical Turk, we specified that only those participants who reported being from the USA would be able to take part in the experiment. This study was reviewed and approved by the Central University Research Ethics Committee of the University of Oxford. All of the participants provided informed consent prior to their taking part in the experiment.

2.1.2. Apparatus & materials

The experiment was conducted on the internet through the Adobe Flash based Xperiment software (http://www.xperiment.mobi downloaded on 30/05/2014). Irrespective of the size of the monitor that the participants used, the experiment ran in 'full screen' mode (i.e., utilising the entirety of the participant's monitor) within a 1024×768 pixel box in the centre of the screen (if the screen was of a smaller resolution, visual information was scaled to fit the screen whilst maintaining aspect ratio).

Photos of circular-, oval-, and diamond-shaped tablets were used as the experimental stimuli (see Fig. 1). After tablet labelling and backgrounds were removed from the images, the tablets were closely cropped using image editing software. The sizes (in pixels) of the circular-, oval-, and diamond-shaped tablets fit within, respectively, 45×45, 62×33, and 67×33 boxes. Each tablet was tinted and modified in terms of its brightness so as to appear red (hex-colour cd1b1b, 1 brightness), light-red (brightness 1.5), green (hex-colour 02af43, 1 brightness), light-green (brightness 1.5), blue (hex-colour 224793, 1 brightness), light-blue (brightness 2), and unmodified as white (modifications were achieved with GreenSock's ColorMatrixFilter, version 12, http://www.greensock.com). Thus, a total of 21 different experimental stimuli (3