Perceived Risk versus Empirically Founded Benefit of Masticating Gum

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Despite robust evidence on the benefits of gum mastication as compared to its risks, places such as Singapore still outlaw chewing gum outside of medicinal purposes. Chewing gum has therapeutic and cognitive benefits such as reduced stress and increased attention, and its associated costs such as littering are disproportionately upheld and still prosecuted against in Singapore. This is a clear example of a policy implemented based on perception rather than cost–benefit analysis. Policies, even as minor as those related to gum mastication, must be entrenched in evidence, and any accompanying costs (eg littering) can and should be deterred through evidence-based communication efforts.

Masticating gum appears to be an innocuous habit, and yet the entire country of Singapore is perceived by the rest of the world to have a strict zero tolerance policy for the behaviour. While many believe that chewing gum is fully banned and that the littering of chewed gum can result in public flogging, the reality of the situation is slightly more nuanced. Severe deterrence policies, however, do exist relative to the nature of the risk.

In 1992, the sale and importation of gum was outlawed throughout Singapore because of the perceived risk associated with littering, which was viewed as particularly detrimental to the then new and expensive underground system. The government was attempting to curb behaviours of vandalism such as the covering of door sensors and the accumulation of chewed gum. Corporal punishment was never associated with gum mastication offenses, but fines up to 100,000 USD could be levied.[1] The ban was overwhelmingly effective in that it belonged to a category of other illegal human behaviours, including general littering to "spitting any substance or expelling mucus from the nose upon or on to any street or any public place".

Singapore's original ban was slightly modified in 2004 following bilateral trade negotiations with the United States, but gum is still currently only available in Singapore for therapeutic purposes through a doctor or licensed pharmacist. Having

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[1] <https://www.theguardian.com/lifeandstyle/shortcuts/2015/mar/23/gum-control-how-lee-kuan-yew-kept-chewing-gum-off-singapores-streets>.

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travelled to Singapore recently, it became clear that the continued restrictions on gum mastication and the costly deterrence policies put in place were entrenched in perceptions of risk reality. Chewing gum has significant therapeutic and cognitive benefits, and the associated costs of littering hardly outweigh the benefits. The draconian deterrence policies put in place do not accurately correspond to the reality of the risk of chewing gum.

The evidence supporting the therapeutic benefits of gum have been validated and replicated through a plethora of studies. Gum chewing generates saliva and can support antibacterial and antiviral responses, and can even help to fight ear infections in children.[2] A 2016 Cochrane Review found that chewing gum with xylitol could help prevent acute otitis media in children up to twelve years of age.[3] Further therapeutic benefits include the chewing of sugar-free gum to supplement dental health. The European Food Safety Authority, for example, concluded that a cause-and-effect relationship has been established between the consumption of sugar-free chewing gum and a reduction of tooth demineralisation, as well as a reduction in the incidence of dental caries, or cavities, and tooth decay.[4]

Researchers have been able to quantify the benefits of chewing sugar-free gum as cost savings across countries because of its role in proactive prevention against negative health outcomes.[5] Rychlik et al (2017) found that the United States and Europe show potential cost savings in dental expenditures due to caries of approximately 2.071 billion USD and 1.061 billion USD per year, respectively, if all chewers increased their consumption of sugar-free gum by one piece per day.

In addition to improvements in cost savings associated with dental health prevention, the evidence for cognitive enhancements associated with gum mastication is also abundant. While some earlier research suggested gum chewing decreased short-term memory performance, extensive reviews of the research have found that gum chewing can enhance alertness and sustain attention.[6] One such study by Morgan et al asked two groups of twenty participants each to listen to a thirty-minute recording that included a sequence of numbers. The group assigned to chewing gum had greater accuracy rates and response times than those in the non-gum-chewing group. Those in the chewing gum group also maintained focus longer throughout the study.[7] Many more studies support and confirm the cognitive benefits of chewing

[2] AG Hanno, NM Alamoudi, AS Almushayt, MI Masoud, HJ Sabbagh and NM Farsi, "Effect of xylitol on dental caries and salivary *Streptococcus mutans* levels among a group of mother–child pairs" (2011) 36(1) Journal of Clinical Pediatric Dentistry 25.

[3] A Azarpazhooh, HP Lawrence and PS Shah, "Xylitol for preventing acute otitis media in children up to 12 years of age" (2016) (8) Cochrane Database of Systematic Reviews CD007095.

[4] K Mäkinen, "Authorised EU health claims for xylitol and sugar-free chewing gum (SFCG)" in *Foods, Nutrients and Food Ingredients with Authorised EU Health Claims* (Cambridge, Woodhead Publishing 2014), pp 46–72.

[5] R Rychlik, F Kreimendahl, C Blaich, H Calache, F Garcia-Godoy, E Kay et al, "A global approach to assess the economic benefits of increased consumption of sugar-free chewing gum" (2017) 30(2) American Journal of Dentistry 77.

[6] AP Allen and A Smith "A review of the evidence that chewing gum affects stress, alertness and cognition" (2011) 9(1) Journal of Behavioral and Neuroscience Research 7; Y Hirano and M Onozuka, "Chewing and attention: a positive effect on sustained attention" (2015) 2015 BioMed Research International 367026.

[7] K Morgan, AJ Johnson and C Miles, "Chewing gum moderates the vigilance decrement" (2014) 105(2) British Journal of Psychology 214.

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gum for sustained attention performance[8] and improved alertness.[9] In addition to sustained attention and improved alertness, there is self-reported evidence of enhanced productivity;[10] however, it remains unclear as to whether or not the increased heart rate from gum chewing and the subsequent general sympathetic nervous system arousal can be linked to enhanced everyday work performance.[11]

There also exists self-reported evidence of chewing gum resulting in stress reduction,[12] as well as significant findings from acute laboratory psychological stress conditions linking gum chewing to reduced state anxiety, stress and salivary cortisol.[13] It appears that there is clearer evidence for an ameliorating effect of gum on chronic stress compared to acute stress. Given this contrast between short- and long-term effects, it remains unclear whether a shorter intervention (eg of one day) can reduce feelings of stress, anxiety and depression in a sample of working adults.[14]

Physiologically, such findings are not surprising. They support the notion that mastication improves regional cerebral blood flow, including in frontotemporal regions that are believed to mediate aspects of memory functioning. Increased oxygen helps people stay more alert and can increase participant reflexes, both outcomes that were not produced by people just pretending to chew gum.[15] Additionally, chewing may promote the release of insulin, which could influence memory via central mechanisms.[16] It is evident that chewing gum has cognitive benefits ranging from sustained attention, improved alertness, better performance and reduced stress and anxiety. While nothing conclusive has been found related to the rate of chewing or particular gum flavour, it is clear that the very act of masticating gum has its benefits.[17]

With all of the cognitive benefits of gum chewing laid bare, it is prudent to understand the risk of gum chewing from Singapore's perspective (ie its role in littering). Up until the 1992 ban on gum chewing, it was reported that Singapore's Housing and Development Board (HDB) spent 150,000 SGD annually to clean up littered gum.[18] Following the ban,

[8] O Tucha, L Mecklinger, K Maier, M Hammerl and KW Lange, "Chewing gum differentially affects aspects of attention in healthy subjects" (2004) 42(3) Appetite 327; A Smith, "Effects of chewing gum on cognitive function, mood and physiology in stressed and non-stressed volunteers" (2010) 13(1) Nutritional Neuroscience 7.

[9] AJ Johnson, M Muneem and C Miles, "Chewing gum benefits sustained attention in the absence of task degradation" (2013) 16(4) Nutritional Neuroscience 153;AP Allen and AP Smith, "Effects of chewing gum and time-on-task on alertness and attention" (2012) 15(4) Nutritional Neuroscience 176.

[10] AP Smith, K Chaplin and E Wadsworth, "Chewing gum, occupational stress, work performance and wellbeing. An intervention study" (2012) 58(3) Appetite 1083.

[11] AP Allen, TJC Jacob and AP Smith, "Effects and after-effects of chewing gum on vigilance, heart rate, EEG and mood" (2014) 133 Physiology & Behavior 244; L Wilkinson, A Scholey and K Wesnes, "Chewing gum selectively improves aspects of memory in healthy volunteers" (2002) 38(3) Appetite 235.

[12] AP Smith, "Chewing gum, stress and health" (2009) 25(5) Stress and Health 445.

[13] A Scholey, C Haskell, B Robertson, D Kennedy, A Milne and M Wetherell. "Chewing gum alleviates negative mood and reduces cortisol during acute laboratory psychological stress" (2009) 97(3–4) Physiology & Behavior 304.

[14] Allen and Smith, supra, note 6.

[15] Morgan et al, supra, note 7.

[16] Wilkinson et al, supra, note 11.

[17] AP Allen and AP Smith (2015). "Chewing gum: cognitive performance, mood, well-being, and associated physiology" (2015) 2015 BioMed Research International 654806.

[18] P Jacob, "Chewing gum may be banned" (*The Straits Times*, 21 November 1983) p 9 <https://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes19831121.2.33>.

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cases for gum littering reduced drastically from 525 to 2 a day in February of 1993. This resulted in significant, but relative, cleaning cost savings across the country's town councils.[19]

This ban was not partially revised until 2004 as part of the United States–Singapore bilateral free trade agreement (FTA) initiated first by former US president Bill Clinton and ultimately concluded during the administration of George W. Bush. Gum chewing made it to the FTA agenda through the lobby efforts of the retail giant Wrigley, despite Singapore being a relatively small market. The explanation for this effort was described not as profit motivated, but rather to allow for equitable access to a product with clear therapeutic benefits. Wrigley's then senior director of corporate communications, Christopher Perille, stated: "There's many examples in our history of things that may have not made short-term financial sense, but was the right thing to do in a philosophical or long-term sense".[20]

Upon reviewing the therapeutic benefits of chewing gum, it is evident that the benefits far outweigh the risks. The therapeutic benefits alone, such as that sugar-free gum contains calcium lactate to strengthen tooth enamel, have a significant body of supportive empirical research. These therapeutic benefits are ultimately what helped Singaporean authorities to allow for a new category of medicinal gum to be established as part of the United States–Singapore FTA. Additionally, a review of the literature on the cognitive benefits of gum chewing also supports the positive outcomes of this behaviour. The risk associated with gum chewing (ie the relatively low cost associated with littering) does not correspond to the draconian deterrence policies still in existence in Singapore.

Singapore's policy on gum chewing is an example of overly burdensome regulations entrenched in perceptions over evidence. Prior to the initial 1992 ban, Singapore attempted and failed to communicate and educate its public on the societal costs associated with littering.[21] Rather than implement sound, evidence-based, effective communication measures for the purpose of changing behavioural outcomes, it turned to strict, blunt policy tools. These tools are not only unnecessarily cumbersome, they also hurt trade and limit Singapore's population from the therapeutic and cognitive benefits of gum mastication enjoyed by the broader global populace. While Singapore's deterrence policies in reality are not quite as corporal as perceived, these unfavourable perceptions are still propagated through the global news media. It is evident from this case study just how significant a role perceptions can play in dictating persistent policies, which Singapore would be prudent to remember in regards to its own national reputation.

[19] D Nathan, "Few chewing gum litter cases now, thanks to ban" (*The Straits Times*, 18 March 1993) p 18 <https://eresources.nlb.gov.sg/newspapers/Digitised/Article/straitstimes19930318.2.26.7>.

[20] <https://www.wsj.com/articles/SB108629672446328324>.

[21] <https://www.wsj.com/articles/SB108629672446328324>.

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