Make it a habit: The effect of nudges on habitual handwashing behavior

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Abstract: This one independent variable with three levels between-subjects experimental study examined the effect of digital nudges on habitual handwashing behavior, recruiting 178 Psychology undergraduates from a Malaysian private university. Participants received weekly nudge posters for a month and then reported on the Self-Report Habit Index (SRHI). Results showed non-significant effects, indicating no support for the hypothesis that there is a significant difference in handwashing habit strength between social norm nudge, incentive nudge, and no nudge condition. The hypothesis positing stronger handwashing habit strength with social norm nudge, followed by incentive nudge, and no nudge was also not supported. Innovative strategies for leveraging big data in digital nudge designs are imperative to unlocking its full potential in inducing novel health behaviors.

Keywords: digital nudge, habitual behavior, handwashing

INTRODUCTION, CONTEXT AND RESEARCH OBJECTIVES

Historically, microorganisms, particularly bacteria and viruses, have posed existential threats to humanity. Past examples like the bubonic plague (Glatter & Finkelman, 2021) and more recent examples like COVID-19 (Khan et al., 2020) have reminded us of our fragility and the need to keep them at bay. In dealing with pandemics originating from these microorganisms, modern responses to these crises typically employ a combination of policy measures and the development of vaccines and other pharmaceutical interventions. Among non-pharmaceutical interventions like mask-wearing policies that governments have enforced in response to the COVID-19 pandemic, handwashing seems to have a substantial protective effect against the risk of infectious diseases (Aiello et al., 2008; Rabie & Curtis, 2006; Xun et al., 2021).

Despite governmental efforts to enforce these policies, compliance remains low overall and significantly decreases over time (Makhni et al., 2021; Makki et al., 2020). As a result, policy analysts have recently shown interest towards integrating a behavioral economics approach, which draws from the understanding that human behavior is heavily influenced by the context in which a decision is made (Kahneman, 2011), into policy making. Specifically, the concept of nudging has garnered growing popularity as it presents an attractive idea for influencing people's behavioral choices by making subtle changes to the context in which it is made (Thaler & Sunstein, 2008). Grounded in decades of research in behavioral science, it may be of public and governmental interest alike to discover the full capabilities and potential of nudges in promoting healthy behaviors like hand-washing that can improve collective well-being.

LITERATURE REVIEW

Nudge

The concept of a nudge was first conceptualized by Thaler and Sunstein (2008, p. 6) who defined it as "Any aspect of choice architect that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives". In other words, a nudge impacts a decision maker's behaviour without reducing their choice set or changing their incentives to perform a certain action (Saghai, 2013). Nudges primarily work on the basis that humans have limited cognitive capacity and often arrive at a decision through automatic processes, also known as System 1 thinking (Kahneman, 2011). Therefore, nudges make use of such effortless processing while retaining freedom of choice. In line with this conceptualization, various studies have produced findings that give credence to the efficacy of nudges in promoting all kinds of behaviours from health behaviours like alcohol and smoking cessation (Nurchis et al., 2023; Zhang & Wang, 2023) to green behaviours like recycling (Byerly et al., 2018; Flygansvær et al., 2021). For example, Kroese et al. (2015) found that by simply re-arranging food positions whereby healthy foods were placed near the cash register, sales of healthy goods nearly doubled in just 1 week.

A quantitative review by Hummel and Maedche (2019) revealed there is considerable variance in the effectiveness of a nudge depending on its type. Specifically, the most popular type of nudge is the default which is based on the tendency for individuals to adhere to the default option or choice (Li & Chapman, 2013). Defaults are by far the most prominent in nudge literature (Hummel & Maedche, 2019) and seem to be robust in eliciting behavioral change (Friis et al., 2017; Ghesla et al., 2019; Taufik et al., 2022; van Kleef et al., 2018) while other types of nudges remain relatively unexplored territories (Beshears & Kosowsky, 2020). Recently, nudging has

evolved into the digital realm, known as digital nudging (Hummel & Maedche, 2019). With the advent of technology, multiple conceptualizations of digital nudging have emerged (e.g. reminder emails, robo-advisers; Bergram et al., 2022). Nonetheless, digital nudges are thought to be analogous to conventional nudges in terms of function and mechanism and are similarly effective (Haile et al., 2020; Hummel & Maedche, 2019; Sharma et al., 2021). The involvement of information technology opens promising avenues for further investigation and its application, offering new perspectives on how the effectiveness of nudges can be maximized through such delivery channels (Bergram et al., 2022).

Nudges and Handwashing Behavior

The implementation of nudges on handwashing behaviors in the literature so far has generally yielded positive results (Dreibelbis et al., 2016; Grover et al., 2017; Naluonde et al., 2018; Prasetyo et al., 2021; Tzikas & Koulierakis, 2023). A recent systematic review by Tzikas and Koulierakis (2023) showed that the relative increase in hand hygiene from nudging interventions can range from 6.4% to as much as 2133.3% over baseline measurements, with the most common nudges being saliency and priming types (Prasetyo et al., 2021). Nonetheless, they point out that while there are some indications of the medium-term impact of nudges on sustaining hand hygiene behavior, their capacity to induce enduring behavioral changes in hand hygiene practices remains to be elucidated.

THEORETICAL FRAMEWORK

Incentive Nudge

Incentives represent a central concept in economics (Dolan et al., 2012), and behavioral economists can design nudges around predictable mental heuristics and insights that enhance incentive schemes (Volpp et al., 2011). Though their representation in the context of nudges is still under debate, they can be relevant in many forms such as monetary and time (Hansen, 2016). One particularly relevant insight is the tendency for individuals to respond differently depending on the description of the same set of options, a cognitive bias known as the framing effect (Li & Chapman, 2013). This phenomenon is explained by prospect theory (Tversky & Kahneman, 1981), which posits that individuals often utilize a reference point to evaluate outcomes based on gains or losses relative to it. Under this assumption, decision-makers may exhibit risk aversion for gains and risk seeking for losses.

In the context of messaging strategies, gain-framed messages may encourage the adoption of risk-averse choices while loss-framed messages may encourage the adoption of risk-seeking choices (Li & Chapman, 2013). When risky decisions are contemplated, potential losses are more compelling than potential gains (Kahneman & Tversky, 1979). The apparent implication suggests that gain-framed messages should hold superior persuasive power for relatively low-risk behaviors like preventative health behaviors than loss-framed messages. Preventative behaviors like handwashing are considered risk-averse as they bear a small cost to avert a larger, uncertain cost in the future (Li & Chapman, 2013). Since handwashing is preventative in nature and is associated with minimal risk or uncertainty, it is likely that gain-framed messages will be more effective in eliciting its performance (Toll et al., 2007). By emphasizing the benefits of handwashing, individuals tend to display risk aversion and may be more motivated to practice it rather than confronting the uncertain risk associated with neglecting it.

Social Norm Nudge

Social norms can serve as a powerful driver for our behavior by acting as cues which inform us of the actions of others in a similar situation (Cialdini, 2003, 2007; Fiske, 2010). Individuals often use social norms as a social reference point, whereby the appropriateness of their behaviors is estimated by comparing them to their perception of social norms (Belle & Cantarelli, 2021; Clapp & McDonnell, 2000). If discrepancies are realized in this process, individuals are likely to exhibit conformist behaviors.

The effect of social norms is also thought to possess automatic components consistent with the cognitive processes associated with System 1 thinking (Dolan et al., 2012). A predominant mechanism through which social norms operate is the availability heuristic (Kahneman, 2011), which influences decision-making based on the most readily accessible thoughts. Social norms can trigger the availability heuristic by constantly bringing normative information to the forefront of the mind and subsequently nudging people into conforming to the behaviors of the majority (Thaler & Sunstein, 2008). Therefore, when given information on the strong social norms associated with the intensive handwashing practices in the community, individuals may adopt it as a standard for self-assessment and subsequently increase their own handwashing behaviors to conform to the established norms.

Cross-Cultural Perspective

Culture is an important factor that can potentially influence cognitive processes underlying persuasion (Uskul et al., 2009). Particular brands and advertisements seem to be more preferrable when they match the cultural theme of the message receiver (Aaker & Schmitt, 2001), and health communication researchers have begun to consider cultural factors in designing persuasive messages (Kreuter & McClure, 2004). Many scholars now believe that messaging appeals like nudges need to be tailored and congruent to people's cultural frames and orientations to be effective and compelling (Dutta, 2007; Uskul & Oyserman, 2010). This notion is further supported by Sunstein et al.'s (2017) multi-national study, where they found considerable variance in trust and approval of nudges across nations. For example, informational nudges seem to be particularly disapproved by Japanese individuals compared to Australian individuals while default nudges are especially disapproved in Russia compared to China. Preliminary results seem to suggest that these findings are due to their differing levels of individualistic worldviews and libertarian leanings (Hagman et al., 2015; Jung & Mellers, 2016).

In culturally tight societies, individual behaviors are often closely monitored and deviance from social norms typically entails harsh punishment (Gelfand et al., 2006; Triandis, 1989). As a result, people in tight cultures are more prone to engage in self-monitoring and social comparison to follow the established norms (Baldwin & Mussweiler, 2018). Collectively, the general tendencies of individuals in tight cultures, coupled with the high social pressure within those cultures, increase their proclivity towards conformity (Cheng & Chartrand, 2003). Given the prominence of cultural tightness in non-western regions like Malaysia (Aktas et al., 2016; Kühnen et al., 2001), the effect of social norm nudges may be stronger than incentive nudges in this context.

Current Study

An analysis of the nudge literature showed that the concept has overwhelmingly been popularized and conducted in a Western context, leaving research from non-Western regions relatively sparse (Murayama et al., 2023). There are compelling grounds to speculate on the potential increased relevance and effectiveness of nudge interventions in non-Western contexts. Specifically, Asians tend to engage in holistic thinking (Choi et al., 2007), where their attention is oriented towards the context of an object (Ishii et al., 2003). Therefore, Asians may pay more attention to contextual cues employed by nudge interventions and subsequently associate them with desired behaviors, strengthening their cognitive links and enhancing the nudge effect (Hildebrand et al., 2018).

To fill the cultural gap in nudges literature and uncover the cultural intricacies of the nudge effect, the current study aimed to investigate the effect of digital nudges on habitual handwashing behavior and answer the research question, "Is there a difference in handwashing habit strength between participants in social norm type nudge condition, incentive type nudge condition, and no nudge condition?", with the following two hypotheses:

H1: There is a significant difference in handwashing habit strength between participants in the social norm type nudge condition, incentive type nudge condition, and no nudge condition.

H2: Being exposed to social norm type nudge will lead to stronger handwashing habit strength, followed by incentive type nudge, and no nudge.

METHOD

Sample

For the pilot study, 19 individuals (seven men, ten women, one non-binary, and one preferred not to say) were recruited from the general Malaysian population. For the actual study, 178 undergraduate Psychology students (24 men and 154 women) from a Malaysian private university were recruited for this study; however, one participant was removed for failing to meet the inclusion criteria, leaving 177 participants in the final sample. Participants were in ages ranging between 18-25 years old (M = 21.33, SD = 1.26) with a majority of them being 21 years old (36.80%; n = 68). Calculations using G*Power 3.1 (Faul et al., 2009), with a conventional effect size value of 0.25, alpha level of 0.05, and statistical power threshold of 0.80 suggested a minimum sample size of 159 for this study.

Materials

Nudge Posters

Two 5 by 7-inch digital posters adapted from Updegraff et al. (2011) were presented to the respective groups once per week for one month. The social norm nudge poster contained a headline reading "Everyone is doing it. Are you?" and a fact box stating that most people are washing their hands to avoid getting COVID-19 to reinforce the theme. This aligns with our understanding of social reference points, offering normative information that enables decision-makers to compare their behavior with higher established standards. The incentive nudge poster contained a headline reading "Stay healthy this season. Wash your hands!" and a fact box stating that handwashing can reduce the chance of contracting COVID-19. It integrates the concepts of the framing effect by presenting it in the form of gains for the decision-maker when performing handwashing.

Self-Report Habit Index

The 12-item Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) was used to measure participants' handwashing habit strength. Examples of items from the index include "I do automatically" and "I do without thinking". Higher ratings on each item indicated greater handwashing habit strength. This index was selected as it demonstrated excellent internal consistency across its applications in past studies ($\alpha > .90$; Gardner et al., 2011).

Procedure

A pilot study was conducted to test the procedures and act as a deception test. The process was the same as the actual study except for participants not receiving any compensation. The deception was tested by asking participants to provide feedback regarding the study's deception through close-ended, and open-ended questions at the end of a Google form after going through the full pilot study procedure.

In the actual study, after registering on the university's online experiment portal and clicking on the recruitment link, participants were led to the informed consent form, where they were informed that this study was investigating the effect of periodic prompts on habitual hand washing rather than the actual title. After indicating their consent for participation, participants were asked to provide their email address to proceed. Then, they were contacted by the researcher through email and provided further instructions with the demographic form. For the next four weeks, participants in the experimental groups were emailed a periodic prompt to wash their hands as well as an online Google form link containing the nudge posters once a week while participants in the control group were not sent anything. At the end of the four weeks, participants were emailed and asked to report on the Self-Report Habit Index (SRHI). After completing the SRHI, participants were led to the debriefing statement. If they were satisfied, participants were thanked for their participation before submitting their responses and awarded extra credit for their contribution.

RESULTS

Descriptive Statistics and Scale Reliability

The means and standard deviations for each experimental group are presented in Table 1. Reliability analysis using the alpha model indicated that the Self-Report Habit Index (SRHI) demonstrated excellent internal consistency in this study ($\alpha = .96$).

Exploratory Data Analysis

Exploratory data analysis was conducted using RStudio (R Core Team, 2021). The distribution of SRHI scores shows no apparent outliers in the dataset. The distribution of gender in the current dataset seemed to be imbalanced, with the number of females being approximately 6.5 times more than males. Males reported slightly greater handwashing habit strength with a larger interquartile range than females. However, the lack of data points for males is noticeable, indicating that it should be interpreted with caution. Participants across three levels of nudges reported similar mean levels of handwashing habit strength. When gender is included, the trend remains consistent among females. Interestingly, the trend differs among males. It is worth noting

that concerns of lack of data points still apply here. Confirmatory data analysis is required to validate and confirm these findings.

Assumptions Testing

The assumption of normality was met for the experimental conditions, social norm, Shapiro-Wilk (60) = .97, p = .080, and incentive, Shapiro-Wilk (62) = .97, p = .106, but was not met for the control condition, Shapiro-Wilk (55) = .94, p = .006. Therefore, the overall assumption of normality was violated, and the following ANOVA results should be interpreted with caution. Nevertheless, the independent one-way ANOVA is robust to violations of normality (Nwobi & Akanno, 2021). Levene's test for equality of variances showed that the assumption of homogeneity of variance was met, $F(2, 174) = 2.61$, p = .077.

Inferential Tests

Table 1

Means, Standard Deviations, and Independent One-Way Analysis of Variances in Handwashing Habit Strength

Variable	Social Norm		Incentive		Control		$F(2, 174)$	η^2
	M	*SD*	*M*	*SD*	*M*	*SD*		
Handwashing Habit Strength	4.11	1.45	4.42	1.44	3.97	1.67	1.34	.02

An independent one-way ANOVA was run to test the hypotheses. According to Table 1, there was a statistically non-significant difference in handwashing habit strength between participants in the social norm type nudge condition, incentive type nudge condition, and control condition, with $F(2,174) = 1.34$, p = .265, partial $\eta 2$ = .02. Therefore, both hypotheses were not supported. Post-hoc analysis was not run as the ANOVA yielded non-significant results.

DISCUSSION

Key Findings

The hypothesis that there is a significant difference in handwashing habit strength between participants in the social norm type nudge condition, incentive type nudge condition, and no nudge condition was not supported. As a result, the hypothesis that exposure to social norm type nudge will lead to stronger handwashing habit strength, followed by incentive type nudge, and no nudge was also not supported.

The results were inconsistent with past studies which found a significant effect of nudges on handwashing behavior (e.g., Huang et al., 2021; Tzikas & Koulierakis, 2023). For example, Dreibelbis et al. (2016) conducted direct observations of behavior change, after traditional handwashing infrastructure was provided, and found rates of handwashing as high as 74% at 6 weeks over 4% before intervention. They stressed that focusing on handwashing infrastructure is important in creating an environment conducive to behavior change. Similarly, Grover et al.'s

(2017) also focused on infrastructure change but included high-intensity hygiene education (HE) as well. Although they found the nudge intervention and HE to be equally effective independently, simultaneous delivery of both was found to significantly outperform sequential delivery. These studies highlight the importance of handwashing infrastructure, and its combination with education-based messaging as critical elements in producing substantial improvements in handwashing behavior, elements that were missing in the present study.

Prasetyo et al. (2021) created a visually appealing digital nudge poster using color saliency and rhyming words to enhance message delivery and recall in both online and offline settings. They found that the visual stimuli significantly increased handwashing intentions compared to controls. Their results indicated that the use of straightforward concepts like visual priming and color saliency in nudge design is crucial in ensuring optimal message delivery. Color saliency played a role in drawing participants' attention to the designated information while visual priming worked on health-related cues to subtly influence handwashing behavior. Based on this rationale, perhaps it is precisely because humans have limited attentional capacity and a tendency to engage in System 1 thinking (Kahneman & Thaler, 2006), that they base their decisions on the most salient stimuli while ignoring other relevant information (Vlaev et al., 2016). Due to the monochromatic and simple design of the current nudge intervention, participants' attention may not have been directed to the specified information, potentially resulting in the misinterpretation of the posters' intended message.

On the other hand, the findings were consistent with previous studies that found non-significant effects of social norm nudges (e.g., Reinholdsson et al., 2022; Richter et al., 2018). Following their results, Brachem et al. (2019) identified factors that increase the likelihood of compliance to social norms and found that its effects are most pronounced when the norm concerns psychologically salient members of in-groups (Cruwys et al., 2012; Stok et al., 2014)). As the social norm established in the present study pertained to the general populace, the influence of social norms may have been attenuated as participants did not strongly identify with the members of the norm.

The results were also in line with prior research indicating a non-significant effect of gain-framed nudges (e.g., Dimant et al., 2020; Waheed, 2023). A possible explanation may be that participants have been excessively subjected to such statements for the past few years since the onset of the pandemic (Dassen, 2021). In the current endemic stage, fears associated with COVID-19 may have already dissipated (Rathakrishnan et al., 2022), leading statements and information from the nudge to be taken less seriously than if it was their initial exposure.

Limitations and Suggestions for Future Research

The findings of the present study should be interpreted with a few limitations in mind. Firstly, the sample was not representative of the general Malaysian population as most of them were female young adults which may affect the generalizability of the findings. Future studies should employ diverse sampling methods like stratified sampling from different demographic groups to mitigate bias introduced by non-representative sampling and ensure the generalizability of their findings.

Another limitation to consider is that the present study did not account for the potential confounds of goal associations and pursuits. Goals facilitate habit formation through increasing attention to specific stimuli and recognizing the value of behavioral outcomes (Wood & Rünger, 2016). Given the numerous interconnections between neural circuits involved in goal-directed and

habitual behaviors, goals can exert a biasing influence towards habit formation (Doll et al., 2012). It is suggested that future studies incorporate valid measures of implicit and explicit goals like the Multi-Motive Grid (MMG; Sokolowski et al., 2000) as covariates in their statistical analyses to better isolate the effects of nudges and improve causal inferences.

Fundamentally, methodological limitations pose some challenges to the validity and generalizability of the findings. Particularly, the present study ran for approximately 4 weeks which is too short compared to other longitudinal studies on habits (e.g., Kaushal & Rhodes, 2015), and is nearly one-third the average time it takes for habits to fully develop (Lally et al., 2010). Notably, habit strength among most of the participants was moderate at best by the end of the study, suggesting that the study duration was not long enough to observe measurable differences in habit formation. Repeated assessments and multiple measurement points are necessary to reveal variations in habit strength from baseline values over time (Gardner et al., 2022). In line with Gardner et al.'s (2022) suggestions, future studies on habit formation should employ longitudinal designs with durations of at least 66 days and incorporate several measurements over multiple time points to increase the likelihood of detecting measurable changes in habit formation.

Theoretical and Practical Implications

The current study attempted to establish causality by studying the effect of digital nudges on novel health behaviors, extending the current nudge and framing literature that has already seen favorable results in eliciting behavioral change. Contrary to what has already been established in the literature (e.g., Tzikas & Koulierakis, 2023), the results were inconsistent with prior studies where nudges had a significant effect. It highlighted the importance of nudge design and implementation in producing its intended effect. Crucially, the involvement of information technology in nudge design introduces new and innovative ways that human behavior can be reshaped. The approach to designing digital nudges seems to be much more nuanced than previously thought and isn't directly transferrable from their conventional counterparts in a straightforward manner. Hummel et al. (2018) pointed out that the lack of effectiveness in digital nudges can be attributed to its lack of being noticed and cognitively processed. Therefore, more assertive methods such as wearables (Bergram et al., 2022), are needed to enhance the impact of digital nudges. For digital nudges to work, they must transcend simple design changes in user interface.

The findings of this digital nudge study established that simple nudges alone may be insufficient to promote long-term behavioral changes at least for handwashing behavior. This data could prove beneficial for governmental bodies interested in utilizing economical digital tools to encourage handwashing behaviors among individuals in society without undermining autonomy. For example, they may use a multi-faceted intervention strategy integrating nudges from behavioral economics with other empirically robust concepts like operant conditioning from other disciplines within the behavioral sciences. A mobile application could be developed where hybrid nudges consisting of several nudging principles are implemented (Jesse et al., 2021). In summary, the provision of various nudging principles complemented by creative uses of data-driven digital technologies presents an exciting approach for promoting handwashing behavior and fostering lasting behavioral changes in individuals.

CONCLUSION

This experiment was conducted to study the effect of digital nudges on habitual handwashing behavior. The findings showed a non-significant difference in handwashing habit strength between participants in the social norm type nudge condition, incentive type nudge condition, and control condition. This suggests that the transfer of nudge implementations into the digital space isn't exactly comparable to conventional conceptualizations. Choice architects need to employ innovative approaches in digital nudge design to ensure its effectiveness in the digital sphere. It is of scholarly interest to test the boundaries and explore the limits of digital nudges, leveraging the wealth of diverse and expansive datasets available.

ACKNOWLEDGEMENTS AND FUNDING

This study was carried out on the 17th of January in the year 2024 in partial fulfilment of the Bachelor of Psychology degree by HELP University. The author thanks the Board of Reviewers for comments upon the submission of this manuscript.

STATEMENT OF ETHICAL CLEARANCE

The study was cleared for data collection by the Ethics Review Board (ERB), Department of Psychology, HELP University. Ethical clearance granted 6th November 2023 (E202310/08).

DATA AVAILABILITY STATEMENT

Data is available upon request from the authors.

DECLARATION OF ORIGINALITY

I declare that the current submission is our work and is not being considered for publication elsewhere. I certify that the referenced work used in this submission has been properly acknowledged in-text and in the reference list.

CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest.

PUBLISHER'S NOTE

The views and claims expressed in this article do not represent the Board of Editors and the Reviewers.

REFERENCES

Aaker, J., & Schmitt, B. (2001). Culture-dependent assimilation and differentiation of the self. *Journal of Cross-Cultural Psychology*, *32*(5), 561–576. https://doi.org/10.1177/0022022101032005003

Aiello, A. E., Coulborn, R. M., Perez, V., & Larson, E. L. (2008). Effect of hand hygiene on infectious disease risk in the community setting: A meta-analysis. *American Journal of Public Health*, *98*(8), 1372–1381. https://doi.org/10.2105/ajph.2007.124610

Aktas, M., Gelfand, M. J., & Hanges, P. J. (2016). Cultural tightness–looseness and perceptions of effective leadership. *Journal of Cross-Cultural Psychology*, *47*(2), 294–309. https://doi.org/10.1177/0022022115606802

Baldwin, M., & Mussweiler, T. (2018). The culture of social comparison. *Proceedings of the National Academy of Sciences*, *115*(39). https://doi.org/10.1073/pnas.1721555115

Belle, N., & Cantarelli, P. (2021). Nudging public employees through descriptive social norms in healthcare organizations. *Public Administration Review*. https://doi.org/10.1111/puar.13353

Bergram, K., Djokovic, M., Bezençon, V., & Holzer, A. (2022). The digital landscape of nudging: A systematic literature review of empirical research on digital nudges. *CHI Conference on Human Factors in Computing Systems*. https://doi.org/10.1145/3491102.3517638

Beshears, J., & Kosowsky, H. (2020). Nudging: Progress to date and Future Directions. *Organizational Behavior and Human Decision Processes*, *161*, 3–19. https://doi.org/10.1016/j.obhdp.2020.09.001

Brachem, J., Krüdewagen, H., & Hagmayer, Y. (2019). *The limits of nudging: Can descriptive social norms be used to reduce meat consumption? It's probably not that easy*. https://doi.org/10.31234/osf.io/xk58q

Byerly, H., Balmford, A., Ferraro, P. J., Hammond Wagner, C., Palchak, E., Polasky, S., Ricketts, T. H., Schwartz, A. J., & Fisher, B. (2018). Nudging pro-environmental behavior: Evidence and opportunities. *Frontiers in Ecology and the Environment*, *16*(3), 159–168. https://doi.org/10.1002/fee.1777

Cheng, C. M., & Chartrand, T. L. (2003). Self-monitoring without awareness: Using mimicry as a nonconscious affiliation strategy. *Journal of Personality and Social Psychology*, *85*(6), 1170–1179. https://doi.org/10.1037/0022-3514.85.6.1170

Choi, I., Koo, M., & Choi, J. A. (2007). Individual differences in analytic versus holistic thinking. *Personality and Social Psychology Bulletin*, *33*(5), 691–705. https://doi.org/10.1177/0146167206298568

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science*, *12*(4), 105–109. https://doi.org/10.1111/1467-8721.01242

Cialdini, R. B. (2007). *Influence: The psychology of persuasion*. Harper Business.

Clapp, J. D., & McDonnell, A. L. (2000). The relationship of perceptions of alcohol promotion and peer drinking norms to alcohol problems reported by college students. *Journal of College Student Development*, *41*(1), 19–26.

Cruwys, T., Platow, M. J., Angullia, S. A., Chang, J. M., Diler, S. E., Kirchner, J. L., Lentfer, C. E., Lim, Y. J., Quarisa, A., Tor, V. W. L., & Wadley, A. L. (2012). Modeling of food intake is moderated by salient psychological group membership. *Appetite*, *58*(2), 754–757. https://doi.org/10.1016/j.appet.2011.12.002

Dassen, L. (2021). *Clean your hands please!: Using nudging to improve hand hygiene amongst Dutch citizens during COVID-19.* [Doctoral thesis, University of Twente]. University of Twente Student Theses. https://purl.utwente.nl/essays/89224

Dimant, E., van Kleef, G. A., & Shalvi, S. (2020). Requiem for a nudge: Framing effects in nudging honesty. *Journal of Economic Behavior & Organization*, *172*, 247–266. https://doi.org/10.1016/j.jebo.2020.02.015

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology*, *33*(1), 264–277. https://doi.org/10.1016/j.joep.2011.10.009

Doll, B. B., Simon, D. A., & Daw, N. D. (2012). The ubiquity of model-based reinforcement learning. *Current Opinion in Neurobiology*, *22*(6), 1075–1081. https://doi.org/10.1016/j.conb.2012.08.003

Dreibelbis, R., Kroeger, A., Hossain, K., Venkatesh, M., & Ram, P. (2016). Behavior change without behavior change communication: Nudging handwashing among primary school students in Bangladesh. *International Journal of Environmental Research and Public Health*, *13*(1), 129. https://doi.org/10.3390/ijerph13010129

Dutta, M. J. (2007). Communicating about culture and health: Theorizing culture-centered and cultural sensitivity approaches. *Communication Theory*, *17*(3), 304–328. https://doi.org/10.1111/j.1468-2885.2007.00297.x

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/brm.41.4.1149

Fiske, S. (2010). *Social beings: core motives in social psychology*. Wiley.

Flygansvær, B., Samuelsen, A. G., & Støyle, R. V. (2021). The power of nudging: How adaptations in reverse logistics systems can improve end-consumer recycling behavior. *International Journal of Physical Distribution & Logistics Management*, *51*(9), 958–977. https://doi.org/10.1108/ijpdlm-12-2020-0389

Friis, R., Skov, L. R., Olsen, A., Appleton, K. M., Saulais, L., Dinnella, C., Hartwell, H., Depezay, L., Monteleone, E., Giboreau, A., & Perez-Cueto, F. J. (2017). Comparison of three nudge interventions (priming, default option, and perceived variety) to promote vegetable consumption in a self-service buffet setting. *PLOS ONE*, *12*(5). https://doi.org/10.1371/journal.pone.0176028

Gardner, B., de Bruijn, G. J., & Lally, P. (2011). A systematic review and meta-analysis of applications of the self-report habit index to nutrition and physical activity behaviours. *Annals of Behavioral Medicine*, *42*(2), 174–187. https://doi.org/10.1007/s12160-011-9282-0

Gardner, B., Rebar, A. L., & Lally, P. (2022). How does habit form? guidelines for tracking real-world habit formation. *Cogent Psychology*, *9*(1). https://doi.org/10.1080/23311908.2022.2041277

Gelfand, M. J., Nishii, L. H., & Raver, J. L. (2006). On the nature and importance of cultural tightness-looseness. *Journal of Applied Psychology*, *91*(6), 1225–1244. https://doi.org/10.1037/0021-9010.91.6.1225

Ghesla, C., Grieder, M., & Schmitz, J. (2019). Nudge for good? Choice defaults and spillover effects. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00178

Glatter, K. A., & Finkelman, P. (2021). History of the plague: An ancient pandemic for the age of COVID-19. *The American Journal of Medicine*, *134*(2), 176–181. https://doi.org/10.1016/j.amjmed.2020.08.019

Grover, E., Hossain, M. K., Uddin, S., Venkatesh, M., Ram, P. K., & Dreibelbis, R. (2017). Comparing the behavioural impact of a nudge-based handwashing intervention to high-Intensity Hygiene Education: A cluster-randomised trial in rural Bangladesh. *Tropical Medicine & International Health*, *23*(1), 10–25. https://doi.org/10.1111/tmi.12999

Hagman, W., Andersson, D., Västfjäll, D., & Tinghög, G. (2015). Public views on policies involving nudges. *Review of Philosophy and Psychology*, *6*(3), 439–453. https://doi.org/10.1007/s13164-015-0263-2

Haile, C., Kirk, A., Cogan, N., Janssen, X., Gibson, A.-M., & MacDonald, B. (2020). Pilot testing of a nudge-based digital intervention (welbot) to improve sedentary behaviour and wellbeing in the workplace. *International Journal of Environmental Research and Public Health*, *17*(16), 5763. https://doi.org/10.3390/ijerph17165763

Hansen, P. G. (2016). The definition of nudge and libertarian paternalism: Does the hand fit the glove? European Journal of Risk Regulation, 7(1), 155–174. https://doi.org/10.1017/s1867299x00005468

Hildebrand, D., Harding, R. D., & Hadi, R. (2018). Culturally contingent cravings: How holistic thinking influences consumer responses to food appeals. *Journal of Consumer Psychology*, *29*(1), 39–59. https://doi.org/10.1002/jcpy.1049

Huang, H. C., Le, N., Battle, M., Villasenor, J. M., & Maule, L. (2021). Nudging handwashing among primary school students in the Philippines: Evidence from a cluster randomized trial. *The American Journal of Tropical Medicine and Hygiene*, *105*(6), 1806–1815. https://doi.org/10.4269/ajtmh.20-0673

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental Economics*, *80*, 47–58. https://doi.org/10.1016/j.socec.2019.03.005

Hummel, D., Toreini, P., & Maedche, A. (2018). Improving digital nudging using attentive user interfaces: Theory development and experiment design. In *Proceedings of the 13th International Conference on Design Science Research in Information Systems and Technology (DESRIST)*. Chennai, India

Ishii, K., Reyes, J. A., & Kitayama, S. (2003). Spontaneous attention to word content versus emotional tone: Differences among three cultures. *Psychological Science*, *14*(1), 39–46. https://doi.org/10.1111/1467-9280.01416

Jesse, M., Jannach, D., & Gula, B. (2021). Digital nudging for online food choices. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.729589

Jung, J. Y., & Mellers, B. A. (2016). American attitudes toward nudges. *Judgment and Decision Making*, *11*(1), 62–74. https://doi.org/10.1017/s1930297500007592

Kahneman, D. (2011). *Thinking, fast and slow.* Farrar, Straus and Giroux.

Kahneman, D., & Thaler, R. H. (2006). Anomalies: Utility maximization and experienced utility. *Journal of Economic Perspectives*, *20*(1), 221–234. https://doi.org/10.1257/089533006776526076

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*(2), 263. https://doi.org/10.2307/1914185

Kaushal, N., & Rhodes, R. E. (2015). Exercise habit formation in new gym members: A longitudinal study. *Journal of Behavioral Medicine*, *38*(4), 652–663. https://doi.org/10.1007/s10865-015-9640-7

Khan, M., Adil, S. F., Alkhathlan, H. Z., Tahir, M. N., Saif, S., Khan, M., & Khan, S. T. (2020). COVID-19: A global challenge with old history, epidemiology and progress so far. *Molecules*, *26*(1), 39. https://doi.org/10.3390/molecules26010039

Kreuter, M. W., & McClure, S. M. (2004). The role of culture in health communication. *Annual Review of Public Health*, *25*(1), 439–455. https://doi.org/10.1146/annurev.publhealth.25.101802.123000

Kühnen, U., Hannover, B., Roeder, U., Shah, A. A., Schubert, B., Upmeyer, A., & Zakaria, S. (2001). Cross-cultural variations in identifying embedded figures: Comparisons from the United States, Germany, Russia, and Malaysia. *Journal of Cross-Cultural Psychology*, *32*(3), 365–371. https://doi.org/10.1177/0022022101032003007

Lally, P., van Jaarsveld, C. H., Potts, H. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology*, *40*(6), 998–1009. https://doi.org/10.1002/ejsp.674

Li, M., & Chapman, G. B. (2013). Nudge to Health: Harnessing Decision Research to promote health behavior. *Social and Personality Psychology Compass*, *7*(3), 187–198. https://doi.org/10.1111/spc3.12019

Makhni, S., Umscheid, C. A., Soo, J., Chu, V., Bartlett, A., Landon, E., & Marrs, R. (2021). Hand hygiene compliance rate during the COVID-19 pandemic. *JAMA Internal Medicine*, *181*(7), 1006–1008. https://doi.org/10.1001/jamainternmed.2021.1429

Makki, F., Sedas, P. S., Kontar, J., Saleh, N., & Krpan, D. (2020). Compliance and stringency measures in response to COVID-19: a regional study. *Journal of Behavioral Economics for Policy*, *4*(S2), 15-24. https://sabeconomics.org/wordpress/wp-content/uploads/JBEP-4-S2-2.pdf

Murayama, H., Takagi, Y., Tsuda, H., & Kato, Y. (2023). Applying nudge to public health policy: Practical examples and tips for designing nudge interventions. *International Journal of Environmental Research and Public Health*, *20*(5), 3962. https://doi.org/10.3390/ijerph20053962

Naluonde, T., Wakefield, C., Markle, L., Martin, A., Tresphor, C., Abdullah, R., & Larsen, D. A. (2018). A disruptive cue improves handwashing in school children in Zambia. *Health Promotion International*, *34*(6), 119–128. https://doi.org/10.1093/heapro/day080

Nurchis, M. C., Di Pumpo, M., Perilli, A., Greco, G., & Damiani, G. (2023). Nudging interventions on alcohol and tobacco consumption in adults: A scoping review of the literature. *International Journal of Environmental Research and Public Health*, *20*(3), 1675. https://doi.org/10.3390/ijerph20031675

Nwobi, F., & Akanno, F. (2021). Power comparison of ANOVA and kruskal–wallis tests when error assumptions are violated. Advances in Methodology and Statistics, 18(2). https://doi.org/10.51936/ltgt2135

Prasetyo, D. B., Sofyan, L., Amin, P., & Piarah, D. (2021). The use of visual priming and saliency to promote handwashing behaviour. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3928394

R Core Team (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Rabie, T., & Curtis, V. (2006). Handwashing and risk of respiratory infections: A quantitative systematic review. *Tropical Medicine & International Health*, *11*(3), 258–267. https://doi.org/10.1111/j.1365-3156.2006.01568.x

Rathakrishnan, B., Singh, S. S., Yahaya, A., Kamaluddin, M. R., & Aziz, S. F. (2022). The relationship among spirituality, fear, and mental health on covid-19 among adults: An exploratory research. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.815332

Reinholdsson, T., Hedesström, M., Ejelöv, E., Hansla, A., Bergquist, M., Svenfelt, Å., & Nilsson, A. (2022). Nudging green food: The effects of a hedonic cue, menu position, a warm-glow cue, and a descriptive norm. *Journal of Consumer Behaviour*, *22*(3), 557–568. https://doi.org/10.1002/cb.2129

Richter, I., Thøgersen, J., & Klöckner, C. (2018). A social norms intervention going wrong: Boomerang effects from descriptive norms information. *Sustainability*, *10*(8), 2848. https://doi.org/10.3390/su10082848

Saghai, Y. (2013) Salvaging the concept of nudge. Journal of Medical Ethics, 39(8), 487–493.

Sharma, K., Zhan, X., Nah, F. F.-H., Siau, K., & Cheng, M. X. (2021). Impact of digital nudging on information security behavior: An experimental study on framing and priming in cybersecurity. *Organizational Cybersecurity Journal: Practice, Process and People*, *1*(1), 69–91. https://doi.org/10.1108/ocj-03-2021-0009

Sokolowski, K., Schmalt, H.-D., Langens, T. A., & Puca, R. M. (2000). Assessing achievement, affiliation, and power motives all at once: The multi-motive grid (MMG). *Journal of Personality Assessment*, *74*(1), 126–145. https://doi.org/10.1207/s15327752jpa740109

Stok, F. M., Verkooijen, K. T., de Ridder, D. T. D., de Wit, J. B. F., & de Vet, E. (2014). How norms work: Self-identification, attitude, and self-efficacy mediate the relation between descriptive social norms and vegetable intake. *Applied Psychology: Health and Well-Being*, *6*(2), 230–250. https://doi.org/10.1111/aphw.12026

Sunstein, C. R., Reisch, L. A., & Rauber, J. (2017). A worldwide consensus on nudging? not quite, but almost. *Regulation & Governance*, *12*(1), 3–22. https://doi.org/10.1111/rego.12161

Taufik, D., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2022). A reversal of defaults: Implementing a menu-based default nudge to promote out-of-home consumer adoption of plant-based meat alternatives. *Appetite*, *175*, 106049. https://doi.org/10.1016/j.appet.2022.106049

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* Yale University Press.

Toll, B. A., O'Malley, S. S., Katulak, N. A., Wu, R., Dubin, J. A., Latimer, A., Meandzija, B., George, T. P., Jatlow, P., Cooney, J. L., & Salovey, P. (2007). Comparing gain- and loss-framed messages for smoking cessation with sustained-release bupropion: A randomized controlled trial. *Psychology of Addictive Behaviors*, *21*(4), 534–544. https://doi.org/10.1037/0893-164x.21.4.534

Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological Review*, *96*(3), 506–520. https://doi.org/10.1037/0033-295x.96.3.506

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, *211*(4481), 453–458. https://doi.org/10.1126/science.7455683

Tzikas, A., & Koulierakis, G. (2023). A systematic review of nudges on hand hygiene against the spread of covid-19. *Journal of Behavioral and Experimental Economics*, *105*, 102046. https://doi.org/10.1016/j.socec.2023.102046

Updegraff, J. A., Emanuel, A. S., Gallagher, K. M., & Steinman, C. T. (2011). Framing flu prevention—an experimental field test of signs promoting hand hygiene during the 2009–2010 H1N1 pandemic. *Health Psychology*, *30*(3), 295–299. https://doi.org/10.1037/a0023125

Uskul, A. K., & Oyserman, D. (2010). When message-frame fits salient cultural-frame, messages feel more persuasive. *Psychology & Health*, *25*(3), 321–337. https://doi.org/10.1080/08870440902759156

Uskul, A. K., Sherman, D. K., & Fitzgibbon, J. (2009). The cultural congruency effect: Culture, regulatory focus, and the effectiveness of gain- vs. loss-framed health messages. *Journal of Experimental Social Psychology*, *45*(3), 535–541. https://doi.org/10.1016/j.jesp.2008.12.005

van Kleef, E., Seijdell, K., Vingerhoeds, M. H., de Wijk, R. A., & van Trijp, H. C. M. (2018). The effect of a default-based nudge on the choice of whole wheat bread. *Appetite, 121*, 179–185. https://doi.org/10.1016/j.appet.2017.11.091

Verplanken, B., & Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, *33*(6), 1313–1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Vlaev, I., King, D., Dolan, P., & Darzi, A. (2016). The theory and practice of "nudging": Changing health behaviors. *Public Administration Review*, *76*(4), 550–561. https://doi.org/10.1111/puar.12564

Volpp, K. G., Asch, D. A., Galvin, R., & Loewenstein, G. (2011). Redesigning employee health incentives — lessons from behavioral economics. *New England Journal of Medicine*, *365*(5), 388–390. https://doi.org/10.1056/nejmp1105966

Waheed, H. (2023). Nudging smokers away from lighting up: A meta-analysis of framing effect in current smokers. *Journal of Behavioral and Experimental Economics*, *104*, 101998. https://doi.org/10.1016/j.socec.2023.101998

Wood, W., & Rünger, D. (2016). Psychology of habit. *Annual Review of Psychology*, *67*(1), 289–314. https://doi.org/10.1146/annurev-psych-122414-033417

Xun, Y., Shi, Q., Yang, N., Yang, N., Li, Y., Si, W., Shi, Q., Wang, Z., Liu, X., Yu, X., Zhou, Q., Yang, M., & Chen, Y. (2021). Associations of hand washing frequency with the incidence of illness: A systematic review and meta-analysis. *Annals of Translational Medicine*, *9*(5), 395–395. https://doi.org/10.21037/atm-20-6005

Zhang, N., & Wang, A. (2023). Behavioral intervention strategies to nudge smoking cessation. *Advances in Psychological Science*, *31*(4), 684–696. https://doi.org/10.3724/sp.j.1042.2023.00684