Manipulating Attention to Improve Health Behaviors

THESIS

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Abstract

Selective attention is a key construct in decision-making, but studies have rarely manipulated attention in the area of preventive health. We propose that attention manipulations can be used as a complement to other theory-based interventions in order to tackle important health challenges.

In five studies, we experimentally manipulated attention to information and options and explore its causal effects on choice and valuation. Using disparate decision paradigms in health domains, incidental attention manipulations produced a measurable impact on preventive health behaviors, though the effect was limited (or nullified) outside of the lab.

A new kind of preference reversal emerged, with covert attention manipulations (caused by the presentation of normatively-irrelevant integers) and overt manipulations (order effects and font size) presumably altering the information processed and the subsequent stream of information processing. In Study 1, directing initial attention towards a healthier snack option increased the likelihood of selecting it. Study 2 tested whether the subtle manipulation in Study 1 was effective outside of the lab using similar manipulations between multiple snack options in a hospital cafeteria, but the effect failed to replicate. In Study 3, changing the order in which healthier breakfast items (fruit) were encountered when entering a hospital cafeteria caused a small increase in the proportion of fruit sales compared to less healthy options (pastries). Stronger, less subtle manipulations may be required in order for the effect to be broadly generalizable.

In order to further test the generalizability of the effect of attention on preventive health choices, Studies 4 and 5 used an attention manipulation (font size) that could be
manipulated more broadly (e.g., in public health campaigns). The results highlighted the active nature of processing highly salient information. In particular, directing attention to negative information (e.g., about vaccine risks) generally decreased choice and monetary valuation whereas directing attention towards positive information increased choice and monetary valuations.

Findings highlight the importance of attention in preventive health decisions ranging from healthy food behaviors to vaccine decisions. Covert and overt attention manipulations can have a positive influence on preventive health behaviors and could be applied in public health campaigns to improve their efficacy.
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# Table of Contents

Abstract................................................................................................................................. ii

Acknowledgments.................................................................................................................. iv

Vita........................................................................................................................................ v

List of Figures .......................................................................................................................... viii

Introduction.............................................................................................................................. 1

Promoting Health Behaviors ................................................................................................. 3

Food-Related Behavior ......................................................................................................... 5

Vaccination Decisions ........................................................................................................... 9

Manipulations of Attention .................................................................................................... 10

Spatial Shifts of Attention ..................................................................................................... 10

Salience and Attention ........................................................................................................... 13

Study 1 – Laboratory Snack Choice ....................................................................................... 15

Methods .................................................................................................................................. 16

Results and Discussion ......................................................................................................... 17

Study 2 – Cafeteria Snack Choice ......................................................................................... 20

Methods .................................................................................................................................. 20
Results and Discussion ............................................................................................................. 22

Study 3 – Cafeteria Breakfast Choice ...................................................................................... 25

Methods ................................................................................................................................. 25

Results and Discussion ........................................................................................................... 26

Study 4 – Vaccine Choice ...................................................................................................... 29

Method .................................................................................................................................... 29

Results and Discussion .......................................................................................................... 30

Study 5 – Vaccine Willingness to Pay ................................................................................. 32

Method .................................................................................................................................... 32

Results and Discussion .......................................................................................................... 33

General Discussion .................................................................................................................. 35

Conclusions ............................................................................................................................ 39

References ............................................................................................................................... 40
List of Figures

Figure 1. Study 1, example of materials used................................................................. 16
Figure 2. Study 1, proportion of participants choosing Baked Lays when attention was
directed towards or away from the Baked Lays in the morning and afternoon.............. 18
Figure 3. Study 2, picture of chips display in the hospital cafeteria.............................. 21
Figure 4. Study 2, proportion of healthy chips purchased by condition......................... 23
Figure 5. Study 2, average daily chip sales.................................................................... 24
Figure 6. Study 4, example of low 1% risk, large font stimulus.................................... 30
Figure 7. Study 4, proportion of participants choosing to vaccinate by font condition and
risk level........................................................................................................................... 31
Figure 8. Study 5, example of low 3% risk, large font condition..................................... 33
Figure 9. Study 5, geometric mean willingness to pay by condition............................... 34
Introduction

In the past century, the causes of death, illness, and disability have changed drastically. Increasingly, negative health behaviors such as tobacco use, excessive caloric consumption, and sedentary lifestyles are replacing communicable diseases as the more major causes of poor health (Mokdad, Marks, Stroup & Gerberding, 2004). Extensive research has examined ways of assisting people to initiate and maintain healthy behaviors and reduce unhealthy behaviors, but limited success has been achieved in translating this research into long lasting, public health interventions (Glasgow et al., 2004). It is often assumed that providing health-related information should be sufficient to motivate behavior, but merely providing information appears to be insufficient. For example, informing patients of genetic risk factors that predispose them to breast, colon, or smoking-related cancers has little effect on cancer screening behaviors and smoking cessation (Marteau & Lerman, 2001). Mixed results exist when providing nutritional information to consumers to reduce caloric intake. Some studies indicate a reduction of calories consumed (Bollinger, Leslie, & Sorensen, 2011) whereas others show no effect (Finkelstein, Strombotne, Chan, & Krieger, 2011) or a paradoxical increase in caloric consumption among those trying to reduce calories (Downs, Loewenstein, & Wisdom, 2009). In the present paper, we suggest that insensitivity to health information may be due in part to information being presented in such a way that it is not attended sufficiently to influence preventive health-related decisions. We experimentally test ways to draw attention to information to increase healthy behaviors and potentially increase the efficacy of public health campaigns.

Selective attention has been a long-standing theme in decision research (Tversky & Kahneman, 1981; Weber & Johnson, 2009). However, studies have not manipulated
early spatial attention in decisions outside of awareness and independent of participant
goals, nor have they examined a possible role for attention manipulations in improving
health decisions. In the present paper, we tested covert and overt manipulations of
attention that orient participants’ spatial attention to the left or right without their
awareness (Studies 1 and 2), that direct attention based on order of presentation (Study
3), and that draw visual attention towards key pieces of information (Studies 4 and 5).

Overt order effects matter in judgment and choice. Both primacy and recency
effects have been demonstrated (e.g., Hovland & Mandell, 1957). In Studies 1, 2, and 3,
we focus on experimental manipulations of initial attention, and therefore primacy
effects, whereas Studies 4 and 5 do not examine primacy or recency per se, but focus
instead on experimental manipulations of attention to specific information within the
body of a textual display.

In terms of initial attention, research shows that options and information presented
first disproportionately influence choices (Carlson et al., 2006; DeKay et al., 2009; Russo
et al., 2006). Mantonakis et al. (2009) demonstrated that wines tasted first were favored
more than later wines. Their primacy effects were large: When choosing between two
wines, 70% of participants preferred the first wine. DeKay et al. (2009) found that when
providing several pieces of risk information (e.g., the risks associated with genetically
modified foods) sequentially, participants’ judgments of whether to support action (e.g.,
banning genetically modified foods) were initially predicted by their attitudes about the
topic. However, the best predictor of the effect of each new piece of information was
participant attitudes immediately prior to evaluating the new information, rather than the
initial judgment. The evaluation of each piece of information depended, not only on
participants’ initial judgments, but also on what information they had seen previously,
and the order in which it was encountered. The initial information, and each additional
piece of information, influenced participants subsequent appraisals. These and similar results have been explained with an information-distortion account that argues that evaluation of first information distorts evaluation of subsequent information (Montgomery & Svenson, 1983; Russo et al., 1998; see also constraint-satisfaction accounts, Simon et al., 2004). Most studies in this line of research have tested hypotheses with relatively similar, liked options (e.g., Mantonakis et al. ’s wines were all identical) or options that were not easily comparable (e.g., Willemsen, Böckenholt, & Jonhson, 2011). Distortion effects are possible in decisions because people are presented with options or information sequentially or they read from left to right (in western cultures) and tend to look left first (Krajbich et al., 2010). Distortion processes are not inevitable, however; information diagnostic of one option’s superiority reduces distortion (Russo et al., 2008).

Some of these distortion and similar effects may be caused in part by conscious expectations that communicators present best options and most important information first (Carney & Banaji, 2008; Klein, 1993). Environmental regularities do appear to exist with early information being more valuable than later information (at least some of the time) and being used to support the use of heuristic processing of information in decisions (Lee & Zhang, 2012). Overt order manipulations thus potentially confound attention effects with expectations. In Studies 1 and 2 of the present paper, we manipulate attention independent of these potential expectations.

Promoting Health Behaviors

When attempting to promote healthy behaviors, public health professionals rely on several theories of behavior change that examine factors at play in the environment and within the individual person that can influence behavior. The ability to draw attention to specific information may be beneficial when used as an adjunct to other
theory-based public health interventions. For example, when promoting vaccinations using a Health Belief Model approach (Janz & Becker, 1984; Rosenstock, Strecher, & Becker, 1988), attention manipulations can draw attention to information within a printed message. The Health Belief Model holds that, in order to change behavior, an individual must first perceive that they are susceptible to a given disease; that the outcomes are severe enough to warrant action; that taking action will result in benefits (e.g., avoiding or lessening disease); and that barriers impeding beneficial health behaviors are surmountable. A message based on the Health Belief model must also contain a cue to action, and reaffirm an individual’s ability to take action (i.e., self-efficacy). With an understanding of which component is most critical, either because it has the greatest impact on behavior, or because the population of interest shows a specific deficit in understanding, drawing attention to the critical component within the message may increase the message’s efficacy. For example, if the intended audience of a message to promote vaccination has shown a lack of understanding of the benefits of a vaccine, attention could be drawn towards the benefit information (reduced risk of disease), in addition to providing all of the other key elements of a message constructed using the Health Belief model.

Although specific theories of behavior change were not examined in the present research, the attention manipulations could be incorporated into a variety of theory-based public health interventions. In particular, Studies 4 and 5 tested the effects of a font manipulation which could be of use in constructing myriad health communications. While presenting a non-relevant integer to direct attention spatially may appear less
broadly applicable, the effects found in Study 1 highlight the important role even subtle shifts of attention can have in decision making when they alter the order in which options are encountered.

Food-Related Behavior

When making food-related decisions, people are not only influenced by characteristics of the food itself, but also by many environmental factors. It can be argued that people’s decisions are in part shaped by the fact that they are unaware of just how many decisions about food and the environment in which it is consumed, they make each day. Most people focus on choices of what to eat for meals and snacks. Even when primed to think of other food-related decisions (such as where to eat, with whom to eat, when to stop eating etc.), Wansink and Sobal (2007) found that participants grossly underestimated the number of food-related decisions they make each day, which may be an indication that these decisions are made outside of individual awareness, or that minimal attentional resources are used during the decision. Moreover, although people concede that external factors, like where we eat and with whom, influence other people’s consumption, they did not believe they were affected to the same extent (Wansink & Sobal, 2007). If people remain unaware of their decisions and the potential effects on their food consumption, it is difficult to provide information to promote better decisions.

The extent to which people are influenced by environmental cues is becoming better understood. Simple things, such as serving dish size (Wansink, van Ittersum, & Painter, 2006), ambient lighting and noise, odors, and with whom you eat can have a large impact on consumption (Wansink, 2004). When attempting to influence food-
related decisions, careful consideration of the eating environment is needed in order to ensure that an intervention is able to overcome the external cues that influence eating behavior.

In addition to external environmental cues, we are also faced with psychological mechanisms that can affect our consumption. For example, how well people are emotionally calibrated is predictive of their ability to make goal-supportive food choices (i.e., choose lower calorie meals when their goal is weight loss). When confidence and abilities are well matched, people more accurately select items from menus that will meet their specific health goals (Kidwell, Hardesty, & Childers, 2008). Incidental affect can also play a role in consumption; those who are sad are more likely to consume a larger quantity (over consume) hedonic food choices, whereas those who are happy are more likely to consume larger quantities of more “utilitarian” food choices (Garg, Wansink, & Inman, 2007).

Even when information intended to improve food related choice is used, it isn’t necessarily used correctly. For example, the increase in availability of foods branded as low-fat was accompanied by an increase in obesity rates. When tested, it was found that labeling a food product as low-fat resulted in increased perceptions of portion size and reduced feelings of guilt from consumption. The result was an overall increase in caloric consumption. Alarmingly, this effect was even greater for the obese (Wansink & Chandon, 2006). Marketing claims of “healthy” fast food chains have also been shown to result in increased caloric consumption. When eating at restaurants such as Subway (considered by many to be a healthier choice), consumers tended to underestimate the
calories included in entrees. In addition, they chose higher calorie drinks, side dishes and desserts. The resulting increase in total caloric intake negated the health benefits publicized by the restaurant.

There are, of course, internal physical cues that influence food decisions. Hunger and satiety are two key physical cues involved in consumption, but both can be influenced by the environment (Wansink, 2004). There are also individual and cultural differences in the extent to which internal cues are used versus external environmental cues. In a survey of French and American participants, it was found that the use of external cues of meal cessation was related to increased rates of obesity, whereas the use of internal cues of meal cessation was related with normal weight. The smaller proportion of obese French versus obese Americans appeared to be attributable to the larger proportion of French participants who relied on internal cues (Wansink, Payne, & Chandon, 2007). This finding is important with regards to interventions that modify the eating environment because it indicates that interventions that attempt to modify environmental cues will have the greatest impact with the population most at risk, the obese.

How information is displayed can affect people’s food choices as well as their perceptions of different foods. When information is presented in a way that is more difficult to process due to cognitive load, people tend to rely on affective (intuitive) sources of information. When the same information is much more easily accessible, people tend to make more deliberative choice. Specifically, when information was easily available, participants chose a healthier option (fruit salad) over a sweeter, higher calorie
option (chocolate cake), but when the same information required more effort to obtain and process, they chose the more affectively laden chocolate cake (Shiv & Fedorikhin, 1999).

With so many different factors that can affect how information is perceived and used, how is it possible to influence people’s food choices? It quickly becomes apparent that providing all the pertinent information isn’t sufficient. A recent movement that involves “nudging” people towards optimal choices and behavior is showing great success. Thaler and Sunstein (2008) introduced the concept of nudging to improve decision making by capitalizing on inherent heuristics and biases (Thaler & Sunstein, 2008). We know many of the factors that influence our decisions; by taking advantage of these factors, we can guide people towards more advantageous options, without restricting choice. Wansink, Payne and Shimizu (2011) found that prepackaging snacks in 100 calorie packages resulted in lower overall consumption, and that the effect was greater for obese participants. In their study, one group was provided 4 100-calorie packages of snack foods while another group was offered one 400-calorie package. The group with four 100–calorie packages reduced their consumption by 25% overall relative to the group with one 400-calorie package, but participants who were obese reduced their consumption by over 50% (Wansink, Payne, & Shimizu, 2011). The smaller package appeared to act as a visual cue indicating a smaller serving size. Other studies have shown that making access to higher calorie foods less convenient in a salad bar reduced consumption of the item as well as total caloric consumption (Rozin, et al., 2011), and
that ordering from a menu with lower calorie items listed first and last also resulted in lower calorie consumption (Dayan & Bar-Hillel, 2011).

In Studies 1, 2 and 3, we used environmental cues intended to subtly direct attention in order to “nudge” participants towards healthier food choices.

**Vaccination Decisions**

Decisions to vaccinate against disease can be examined within the Health Belief model. Chapman and Coup (1999) studied what factors influence the healthy individual’s decision to vaccinate and found that the factors were similar to those that influence decisions of high risk individuals in poor health. Key predictors included the perceived effectiveness of the vaccine, the likelihood of any vaccine side effects as well as past vaccination decisions. This research follows up on previous research that examined vaccination intentions based on the health belief model (Larson, Olsen, Cole, & Shortell, 1979). Retrospective analysis of vaccination decisions showed that those who chose to vaccinate felt that they were more susceptible to disease and that the vaccination was more effective. Those who chose to vaccinate also rated the vaccine as less expensive than those who chose not to vaccinate, indicating a greater valuation of the vaccine. Further support of the link between risk perceptions and vaccination intentions has been shown through a meta-analysis of past research (Brewer et al., 2007) and indicates that the relationship may be even greater than past individual studies have indicated.

Drawing attention to risks may increase the efficacy of existing public health campaigns, such as post-card reminder programs. Such reminders may contain several pieces of information, and focusing attention on certain aspects, such as susceptibility to disease or risks of not getting vaccinated could make such communications more
effective. In Studies 4 and 5, we used a font manipulation to draw attention towards vaccine risk in order to influence vaccine choice and valuation.

**Manipulations of Attention**

Attention can be directed in a number of ways. Researchers, for example, can overtly control the order in which information is encountered (e.g., provide one wine to taste and then the next). Such strict control over order can occur outside of the laboratory (e.g., the order in which a physician presents treatment options or the order of information in a nutrition facts box), but order (and other attention manipulations) are often not considered explicitly in terms of their impact on healthy behaviors. In the present paper, we examined multiple attention manipulations across diverse judgments and decisions to test the causal effect of attention and illustrate its rich potential. The manipulations were chosen such that, when faced with multiple stimuli or sources of information, participants’ attention would naturally be directed or drawn to a specific option or piece of information.

**Spatial Shifts of Attention**

Based on information-distortion and other order-effect studies, simply shifting visual attention so that it alights on one option first versus a different option may create preference reversals. We examined a novel method of directing visual attention based on the left-to-right spatial orientation of the mental number line. Dehaene et al. (1993) demonstrated that participants associated left space with smaller numbers (e.g., “1”) and right space with larger numbers (e.g., “9”), called the SNARC (Spatial-Numerical Association of Response Codes) effect. Although number symbols are not obviously directional, Fischer et al. (2003) found that their mere presentation could direct initial
spatial attention: participants detected a target in left visual space faster when it was preceded by a smaller number (1 or 2) and detected a target in right visual space more quickly when preceded by a larger number (8 or 9) as if their attention was already shifted left and right, respectively, by the integers. In order to investigate whether this direction of attention could influence choice, Peters (2010) tested a simple decision paradigm by presenting two identical erasers, with either a 9 or a 1 between them, and having participants choose which they would like to receive. She hypothesized and found that participants were more likely to choose the eraser on the right when the 9 was present, but were more likely to choose the eraser on the left when the 1 was present. This was a simple choice between identical options. It is not clear whether such incidental attentional shifts (produced by the 1 and 9) could influence high-level cognitive processes involved in health or other decision making; looking in the direction of information does not necessitate its processing or use. Numbers’ attention-orienting effect is covert, brief, unrelated to decision goals, and occurs outside of participant awareness (Fischer et al., 2003) so that opportunities to influence decisions are limited. However, because decisions depend on automatic and deliberative processes and attention is limited (Weber & Johnson, 2009), an initial “mere look” at information (a covert order effect, in a sense) could result in its processing and use. Further, that “mere look” could, in some instances be enough to construct individual preferences on the spot similar to Zajonc’s findings (1980) that mere exposure to a stimulus increased preferences for it.

Meilleur and Peters (under review) further explored the underlying mechanism involved by presenting a complex decision paradigm with a choice between two vacation options. Option A had average attributes (e.g., average weather) while option B contained both positive and negative attributes but no average attributes. Option A was always
presented on the left, and Option B on the right with either a 1 or 9 presented between the two options. Additionally, the attributes of Option B were listed with either the positive or negative attributes on top. The results supported the notion that the mere presence of these Arabic integers could direct attention and alter subsequent choices. Specifically, when a 1 was presented, participants chose Option B approximately 60 percent of the time. But when a 9 was presented, choices depended on the order (top to bottom) in which the attributes for Option B were listed. When positive attributes were listed first (on top), participants chose Option B 85 percent of the time, but chose it only 48 percent of the time when its negative attributes were listed first. The authors argue that this differential effect of the attention manipulation is due to the active processing of initial information that is attended. The active processing could result in initial information being weighed more or distorting information that follows (e.g., Dekay et al., 2009). For example, a participant who first reads about the resorts beautiful beaches may then be may perceive negative information regarding the comfort of the room as less of a deterrent to choose the vacation spot compared to another participant who read the negative information about the room first and who subsequently is less impressed by information about the beautiful beaches.

When the attributes of a given choice were clearly outlined for participants in a hypothetical choice, the presentation of a 1 or 9 had an effect on their choice. Whether this effect would remain when the different option attributes weren’t explicitly listed was unknown. Moreover, although the attentional manipulation affected participant’s hypothetical decision about a vacation they might take in the future, could it also affect their choice between options for immediate consumption? To test these questions, we conducted a series of 3 studies in which two main attributes, taste and health, are traded off in a choice between food options. In Studies 1 and 2, we presented an incidental
Arabic digit, physically located between two choice options. We hypothesized that visual attention would shift to the left (“1”) and right (“9”) options; information attended first was expected to disproportionately influence information processing and choice – a mere-looking effect. In Study 1, undergraduate students chose between healthy and unhealthy snack options. In Study 2, patrons of a hospital cafeteria chose between multiple healthy and unhealthy snack options. In Study 3, we relied on the order in which breakfast options were encountered by patrons entering a hospital cafeteria, in order to direct attention to healthy and unhealthy choices. We hypothesized that initial attention towards healthier options would result in a larger percent of purchases of healthier options.

Salience and Attention

Properties of the decision stimuli themselves can influence attention. Stimuli that are perceptually salient draw attention (Parkhurst, Law, & Neiber, 2002) and tend to have greater influence on choice (Bettman, Luce, & Payne, 1998). For example, in a men’s clothing store, a red tie placed in a display of neutrally colored ties may capture attention and be chosen more often than the same red tie in a display of vibrant colors. Visual salience can be manipulated in a variety of ways. In an unpublished dissertation, for example, Sagara (2009) found that participants were more sensitive to different levels of numeric information when the numbers were printed in a font that contrasted more with other provided information. In particular, numeric product information that was italicized and printed in grey (in contrast with the regular black font of the surrounding information) appeared to increase the salience of the numeric information, and to result in a greater impact of the numbers on participants’ product judgments. In Studies 4 and 5, we build off this prior research by asking undergraduate students to make vaccination
decisions. In both studies, we varied the risks associated with the vaccination and the font size in which risks were printed in order to increase salience and draw attention to the risks. We hypothesized that increasing the font size of the risk would draw participant attention towards it, increase their sensitivity to risk, and alter vaccination decisions.

In summary, through a series of 5 studies we explored how preventive health behaviors can be affected by subtly and covertly shifting attention towards a specific option or attribute within a choice paradigm.
Study 1 – Laboratory Snack Choice

Shafir et al. (1993) concluded that the act of choosing between two options (as opposed to rejecting an option) highlights the positive attributes of options under consideration. In Study 1, we asked participants to choose between two options with opposing positive attributes – one option tasted better, the other was healthier. Based on Shafir et al., we expected the positive attributes of the option looked at first (whether better taste or health) to be highlighted. We hypothesized that these positive attributes then would be actively processed and have a disproportionate influence on choice, creating a preference reversal. We also had the intuition that participant norms should matter. In particular, choices made in the morning should reflect a “healthy breakfast” norm and be less susceptible to our attention manipulation.

In Study 1, we attempted to direct attention with the presentation of an Arabic integer (1 or 9) and we examined the impact of mere looking on choice. We tested the effects in a familiar choice between regular and baked potato chips. To compare the attention-directing effect of the “1”, we included a control condition consisting of a blank space between options. No such control existed in prior research (e.g., Fischer et al., 2003). In western cultures where text is read from left to right, a natural bias exists to look left first if faced with two options (Armel, Beaumel, & Rangel, 2008; Krajbich, et al., 2010). Thus, we expected similar left-choice biases in the control and “1” conditions if the “1” indeed directed attention to the left.
Methods

Undergraduate students (N=156) participated for course credit. After completing an unrelated study, participants were advised that they could choose a free snack for their participation. To avoid experimenter influence, participants entered a room alone to “select a snack off the table.” On the table was a poster-board (Figure 1) on which an empty bag of Regular Lays potato chips (unhealthy option) and an empty bag of Baked Lays (healthier option) were displayed with a “1”, “9”, or blank between them. Directly beneath each empty bag of chips was a corresponding bag of chips on the table, for participants to take. After selecting a snack, participants were debriefed, and their selection and the time of day were noted. After each participant made their choice, the room was reset for a new condition using a different poster-board for the condition and placing the chips on the table in the appropriate order corresponding with the poster-board. The left/right order of the chips and the center stimulus were counterbalanced resulting in a 2 (order: Baked Lays left, Baked Lays right) x 3 (center stimulus: “1”, “9”, blank) between-participant design.

Figure 1. Study 1, example of materials used.
Results and Discussion

We first compared data in the “1” and control conditions using logistic regression of choice with order, center stimulus, time of day, and their interactions as predictors. Each predictor was mean centered (coded -0.5 and 0.5) except for time of day (coded 1 for mornings and 0 for afternoon). As expected, a significant left-choice bias existed (Wald $\chi^2$ (df=1)=85.8, $p=0.02$). When the healthier baked chips were on the left versus the right they were chosen 65% versus 34% of the time, respectively. As expected based on the “1” and control having similar effects, no other predictor attained conventional significance. In further analyses, we collapsed data from these two conditions to compare against the 9 condition.

Data were then coded based on whether attention was thought to be directed towards or away from the Baked Lays (i.e., coded as +0.5 in the blank/”1” conditions with Baked Lays on the left and in the “9” condition with Baked Lays on the right and coded as -0.5 otherwise). Time of day was coded as 1 for morning and 0 for afternoon. A logistic regression of choice using attention direction, time of day, and their interaction revealed a significant preference reversal; 64% versus 44% of participants chose Baked Lays, respectively, when attention was directed towards Baked Lays versus away from them (Wald $\chi^2$ (df=1)=10.98, $p=0.001$). This effect was modified by time of day (Wald $\chi^2$ (df=1)=5.41, $p=0.02$). As expected, directing attention influenced choices during afternoon sessions, but the attention manipulation had no effect on morning choices (see Figure 2), presumably because participants were more focused on making choices consistent with “healthy breakfast” norms. The simple effect of time of day was not significant.
Study 1’s results supported the allocation of spatial attention predicted by the SNARC effect and extended its effects to a health related choice where participants likely had pre-existing preferences. Participants were more likely to choose whatever they looked at first. We interpret these findings as consistent with the attention-directing power of integers (the SNARC effect), the act of choice highlighting positive attributes (Shafir et al. 1993), and a disproportionate influence of information (positive information in this case) considered first. We also demonstrated that time of day had an important moderating effect. Choices between these afternoon-appropriate snacks were influenced by the attention manipulation and the active processing that ensued. Chips, however, are a less usual morning snack, and more of the participants chose the healthier snack regardless of the attention manipulation (58% in the morning compared to 50% in the afternoon). We argue that this result is consistent with healthy breakfast norms. Further research is needed to uncover other important moderators of attention manipulations.

If generalizable outside of the lab, covert manipulations of attention could result in significant improvements in healthy eating behaviors. For example, in the realm of

Figure 2. Study 1, proportion of participants choosing Baked Lays when attention was directed towards or away from the Baked Lays in the morning and afternoon.
food choice where providing detailed nutritional information has had mixed effects on caloric intake, it is possible that covert manipulations of attention could assist consumers in making healthier choices where nutritional displays have failed. In Studies 2 and 3, we test the generalizability of manipulating initial attention in a hospital cafeteria
Study 2 – Cafeteria Snack Choice

The results from Study 1 are promising in their potential applications, but the controlled environment of the laboratory limits their possible generalizability. In reality, when choosing a snack, we may have dozens of options to choose from, and choices vary widely in visual appeal, particularly in a retail environment. In addition to that, variations in lighting, ambient noise, inviting smells and other environmental queues can influence our preferences on the spot (Wansink, 2004). In order to test the generalizability of the effect outside of a lab, in Study 2 we tested whether covert manipulations of spatial attention (presentation of “1” and “9”) as well as overt manipulations (arrows left and right) could affect choice when competing for attention with the many auditory, visual and olfactory distractors that exist in a natural environment such as a cafeteria.

Methods

Study 2 was conducted in a Hospital Cafeteria. Participants were customers who purchased potato chips between September 18th and December 4th, 2011. Using the same premise as in Study 1, we introduced several different stimuli between two potato chip displays in order to direct attention either to the left, or to the right. In addition to using the numbers “1” and “9”, we also used arrows left and right (→,←) to more overtly direct attention. Each experimental condition was put in place for two consecutive weeks; sales data were captured on a daily basis. At the end of each experimental condition, we placed
a blank stimulus in between the two displays to act as a control for one week and reduce possible spillover effects. Prior to the beginning of the experiment, the different chips were classified as either “healthy” or “unhealthy” based on the number of calories they contained per ounce. The chips were then placed on separate display shelves directly in front of the cafeteria cashiers so that they would be seen by all customers as they paid for their purchases and exited the cafeteria. Throughout the duration of the experiment, the healthy chips were placed in the right hand display, while the unhealthy chips were displayed on the left. We did not manipulate the order (left/right) in Study 2, as it would have been too disruptive and drawn attention to the fact that an experiment was in progress. Customers and employees who asked questions about the stimuli being used were told that they were inventory tags and were part of a new inventory control system.

Figure 3. Study 2, picture of chips display in the hospital cafeteria.
Results and Discussion

Sales data were analyzed based on the daily proportion of sales for individual chips types (e.g., daily percent of all chip sales for Regular Lays), and by comparing the overall proportion of sales for healthier versus less healthy chips. The data were analyzed using the general linear model. Contrary to our expectations, and Study 1’s results, we found no effect of the attention manipulations on sales of healthy versus unhealthy chips. Figure 4 shows the percent of healthy chip sales for each condition. As shown in the figure, no group differences emerged, $F(5,96) = .17, p = .98$.

We also tested for a differential effect of the numbers (1, 9) and the symbols (↔, →) and a combined effect of the left (1, ↔) and right (9, →). Again, none of the effects approached statistical significance ($t = -0.27, p = .79$).

One important note regarding the differences in the healthy and unhealthy chip choices is that there is an obvious preference for the less healthy chips. Daily sales of each unhealthy chip type were much greater than the healthier choices ($M=5.37$ ($SD=3.95$) unhealthy versus $M=3.76$ ($SD=3.16$) healthy), $F(1,905)= 44.69, p<.0001$. Figure 6 shows the average daily sales (number of bags of chips) by chip type. Examination of this figure reveals that the 4 unhealthy chips with the largest daily average sales all have a larger number of sales than the most popular healthy chips option. It may be that existing strong habits (to purchase the less healthy chips) attenuated the effects of our subtle attention manipulation.

However, the lab results from Study 1 suggest that the subtle shift of attention may influence choice even when people, presumably, have pre-existing preferences. An
alternative explanation for the lack of effect in the cafeteria is that the competition for visual attention within the cafeteria may have been too great for our manipulation to succeed. The cafeteria is a very “noisy” environment with many competing smells, sights, and sounds. Our stimuli simply may have failed to capture the attention of cafeteria customers, leaving the stimuli (e.g., 1 and 9) unable to direct attention.

Figure 4. Study 2, proportion of healthy chips purchased by condition
Figure 5. Study 2, average daily chip sales
Study 3 – Cafeteria Breakfast Choice

In Study 2, we did not test a left/right order effect of the displays. However, based on the left-choice bias found in Study 1, we expected that a bias towards choosing the option on the left would have been a likely result if we had done so. In Study 3, we directly test order in the same cafeteria as Study 2 to see whether order can affect choice between healthy and unhealthy breakfast foods.

Methods

In Study 3 we took advantage of an existing breakfast bar used to display fruit on one side and a selection of pastries on the other. When morning visitors enter the cafeteria, the majority do so via a side entrance adjacent to the breakfast bar. This provided the opportunity to test whether the order in which customers view the breakfast bar items could influence their choice. The breakfast bar is divided into two sections with one section closest to the entrance, and therefore more likely to be seen first by customers entering the cafeteria. Prior to the experiment, the breakfast bar was always set up so that customers would first see the pastries when they entered the cafeteria. During our experiment, we alternated whether the fruit or the pastries were closest to the entrance. We chose to alternate several times for shorter periods to try to account for any seasonal decreases in fruit sales. During data collection, it was determined that not all items were consistently available over weekends. As such, we included in the analysis only data collected during the week day breakfast period from 6:30am to 9:30am.
Results and Discussion

As our hypothesis is dependent on most customers entering the cafeteria through the side entrance away from the cashiers, we counted traffic flow through both entrances on two separate days, between 7 and 9:30am. On September 19th 2011, 86% of customers entered via the side entrance; 82% did so on September 20th. Based on this data, we felt that a sufficiently large majority of customers were entering through the door closest to the breakfast bar to allow us to proceed with the experiment.

We expected: 1) to see an increase in sales for the item type closest to the side entrance (away from the cashier) and 2) to see a seasonal decline in the amount of fruit sold each week as the experiment progressed further into the winter season. Using a general linear model, we tested whether the daily proportion of fruit sales (compared to pastries) was affected by the order of presentation and the natural seasonal decline. Seasonal decline measured using the week (1 through 10) of data collection was a continuous variable and mean centered; order of presentation was also mean centered in all of the analyses. We found a strong seasonal decline in the proportion of fruit sold on a weekly basis $F(1,25) = 10.67, p = .002$. When controlling for this seasonal decline, we found marginally significant results of the order of fruit versus pastry in proximity to the side entrance, $F(1,45) = 2.92, p = .095$. When the fruit was closest to the cafeteria entrance, the proportion of fruit sales from the salad bar was slightly higher than when pastries was closest (26% vs. 23%, respectively, of sales were fruit rather than pastries).

Although the effect of changing the order of foods in the breakfast bar does not meet the normal threshold for significance required to reject the null hypothesis ($p<.05$),
it does indicate that an effect is possible. When we originally calculated the sample size required to achieve significant results, we calculated it based on the total number of sales. The data available, however, is based on the daily proportion of fruit sales versus pastries. As a result, our sample size was reduced from the total number of sales to the total number of days where data was collected. The order manipulation we used in Study 3 has a small to medium expected effect of $R^2 = .05$. At this expected effect size, we would need at least 64 data points per condition in order to achieve enough power to be able to confidently identify any effects (e.g., collect data for 64 days per condition compared to the average of 20 days per condition that we were able to obtain). For comparison, the large effect that we saw due to the seasonal decline ($R^2 > .10$) would require only 26 data points per condition to have sufficient power.

Because of the low power available for our study, we analyzed our data using the Wilcoxon Rank Sums test and the effect of condition approached significance with $z=1.59$, $p = .057$, without controlling for the seasonal decline in fruit sales. It is further indication that, with additional data, we might see a significant effect from the order of presentation. When the fruit is closest to the main cafeteria entrance, more people appear to choose it. However, an alternate explanation for our marginal result could also be that, during our last week of data collection, the pastries were closest to the cafeteria entrance. With seasonal declining fruit sales not controlled for, our effect may be due to an increase in the seasonal decline at the end of the study that skewed the overall results.

Although additional data is required before we can conclusively say that our manipulation influenced customer’s breakfast choices, even such a small increase in the
proportion of fruit sales could affect population health. For example, if a single repeat customer chose fruit over pastries once a week, reducing caloric consumption by approximately 300 calories, over a year their caloric reduction would be more than 15,000 calories, equating to over 4 pounds of weight lost.

In Studies 1, 2 and 3 we attempted to subtly nudge people to make better nutritional choices. In some preventive health decisions, however, informed choice has value in and of itself. As a result, nudging choices directly, as we did in Study 1 may not be an acceptable solution. Instead, manipulations may be more useful that assist consumers to use information that might otherwise be overlooked. Many health related decisions are made while consulting written information, and the volume and complexity of that information can be overwhelming. Drawing attention to a specific piece of information, rather than directing attention left or right or manipulating the order of presentation, may help people make more informed preventive health decisions. In Studies 4 and 5, we focused on an easy-to-use manipulation of stimulus salience to draw attention to specific risk information about a vaccine.
Study 4 – Vaccine Choice

In Studies 4 and 5, we attempted to draw attention to specific information by increasing the font size of target information relative to surrounding information. We hypothesized that when attention is drawn to a positive attribute (low vaccine risk) or negative attribute (high vaccine risk), the attribute will be actively processed which, in turn, will increase the impact of the information on participants’ judgments and choices. We manipulated the salience of risks from a vaccine by printing risks in a large font (high salience) or small font (low salience) relative to the rest of the information display. Drawing attention to vaccine risk information should increase decisions to vaccinate when vaccine risk is low and decrease them when vaccine risk is high.

Method

Undergraduate participants (N=191) were presented with a scenario in which a new flu vaccine was being offered during a flu pandemic. The risk of contracting the flu (flu risk) without the vaccine was held constant at 10% across conditions. The risk of contracting the flu from the vaccine (vaccine risk) was varied along with the font size resulting in a 2(Vaccine risk: Low 1%, High 10%) x 2(Font: Large font, small font). The experiment was programmed in HTML with Times New Roman font; all text except the vaccine risk was set to size 4 (about 14-point font). In the small font condition, vaccine risk was presented in font size 2 (about 9-point font); the large font condition presented risk in font size 6 (about 22-point font). Participants were asked to indicate their choice to vaccinate or not (see Figure 7).
Results and Discussion

Logistic regression of choices using the mean centered variables of vaccine risk and font size, as well as their interaction as predictors revealed a significant main effect of vaccine risk; 70% versus 38% of participants, respectively, chose to vaccinate when the vaccine risk was 1% versus 10% (Wald $\chi^2$(df=1)=18.98, $p<0.001$). There was no main effect of the font manipulation ($p=.10$), but a significant interaction existed between risk level and font size (Wald $\chi^2$(df=1)=15.33, $p=0.02$). When the numeric risk from vaccine was printed in a large font, vaccine risk significantly influenced choice; 82% chose to vaccinate when the vaccine risk was low compared to only 34% when the vaccine risk was high (Wald $\chi^2$(df=1)=20.92, $p<0.0001$; see Figure 8). When the numeric risk from vaccine was printed in a small font, participants were relatively insensitive to vaccine risk; 57% and 40%, respectively, chose to vaccinate when numeric vaccine risk was low (1%) compared to high (10%) (Wald $\chi^2$(df=1)=.72, $p=0.4$). Drawing attention to positive information (the low likelihood of a side effect) using the large versus small font increased choice (82% compared to 57%, respectively; Wald $\chi^2$(df=1)=7.02, $p=0.008$);
drawing attention to negative information (the high likelihood of a side effect) decreased choice directionally (35% and 40% in large and small font conditions, respectively; Wald \( \chi^2 (df=1)=0.25 \ p=0.61 \)).

It is important to note that, although font types have frequently been used to manipulate fluency (i.e., the relative ease of processing stimuli; Shah & Oppenheimer, 2007), our results are not consistent with a fluency explanation. Fluency research predicts that increased ease of processing should result in a general positive increase in appraisals (e.g., increased intentions to vaccinate in both the 1% and 10% risk conditions when printed in a large font) or it predicts that decreased ease of processing (e.g., with the small font that was somewhat difficult to read) should lead to increased information processing and perhaps greater sensitivity to risk levels (Alter, Oppenheimer, Epley, & Eyre 2007). Instead, we found that participants were more sensitive to risk levels when the vaccine risk was printed in the more attention-grabbing larger font. This effect could be due to participants weighing the information more and/or deliberating to a greater extent about it.

Figure 7. Study 4, proportion of participants choosing to vaccinate by font condition and risk level.
Study 5 – Vaccine Willingness to Pay

Studies 1-4 focused on choices between different options. In preventive health decisions, a preference to act one way or another may not be sufficient to initiate action. Actions that serve to maintain health and prevent disease often carry significant cost, either monetary or temporal (e.g., the time involved in seeking treatment), that may dissuade a consumer from action despite initial intentions. To test whether attention could also affect the perceived value of a preventive health option, Study 5 participants indicated their willingness to pay for a vaccine.

**Method**

Study 4 participants also completed Study 5; two participants failed to provide responses, resulting in a final N=189. Participants read a scenario describing a new vaccine for a fictitious disease, Xederitis, which can cause inflammation in the brain possibly leading to brain damage or paralysis. The new vaccine also had a risk of side effects including temporary paralysis. Using a similar method as Study 4, the risk of contracting the disease without the vaccine was 10% for all participants. The risk of side effects from the vaccine were varied in a 2 (Risk: 3%, 12%) x 2 (Font: Large font, small font) design, and participants were asked how much they would be willing to pay to receive the vaccine. Font size was manipulated in the same fashion as in Study 4. Figure 9 shows an example of the stimulus used.
Results and Discussion

Participant responses were log transformed to correct for non-normality and then analyzed using multiple regression with the predictor variables font and vaccine-risk mean centered. The results showed a similar pattern to those of Study 4 (omnibus $F(3,185) = 5.02, p = .002, R^2 = .075$). There was a main effect of risk from vaccine, $t(1) = -2.91, p = .004$, partial $r^2 = 0.043$, with participants in the 3% risk condition willing to pay more than those in the 12% condition (Geometric means$^1 = $78.36 and $35.62$, respectively). Font size was not significant ($p = .29$), but the interaction between vaccine risk and font size was significant, $t(1) = -2.30, p = .02$, partial $r^2 = 0.028$. Figure 10 displays the geometric means for each condition. As found in Study 3, drawing attention to a positive attribute – a small vaccine risk – using a large versus small font, resulted in an increased monetary valuation of the vaccine, $t = 2.55, p = .01$. Conversely, drawing attention to a negative attribute – a large vaccine risk – resulted in a non-significant decreased monetary valuation of the vaccine, $t = -0.82, p = .41$. This null effect is similar to the findings in Study 4; when the risk from vaccine was the same as the risk from the

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$^1$ The geometric mean ($G = \sqrt[n]{x_1x_2...x_n}$) is a measure of central tendency which normalizes the mean so that it is not unduly influenced by large outliers. The log of the geometric mean is the arithmetic mean of the log transformed data.
flu, the large font (compared to the small font) resulted in a non-significant decrease in vaccination intentions.

Figure 9. Study 5, geometric mean willingness to pay by condition.
General Discussion

In five experiments, we tested the effects of covert and overt manipulations of attention on choice and monetary valuations. Such manipulations can be considered as a “nudge” (Thayler & Sunstein, 2008) towards a specific choice or piece of information intended to improve decision making. In health decisions, attention towards positive information about an option increased choices and valuation of that option, whereas attention towards negative information about an option generally decreased choices and valuation of it. In Study 1, covertly directing attention towards a healthier snack option increased the likelihood that participants chose it. If replicable in the “noisier” environs of real life, this finding could have significant impact on health through decreased caloric intake. Rozin and colleagues (2011), for example, found that putting higher calorie items in a salad bar at a further distance from customers led to reduced consumption of the items and a reduction in total calories purchased. Although they did not interpret their findings in terms of attention, it seems plausible that items located in closer proximity were looked at first, and this initial attention could have driven choice processes. Unfortunately, we were unable to replicate Study 1’s results in the cafeteria environment of Study 2.

The effects of Study 1 could have been due to the attention manipulation merely exposing participants to one option for which they automatically developed a preference (Zajonc, 1980). The previous findings by Meilleur and Peters (under review) contradict this explanation due to the differential effect found when positive or negative attributes where highlighted first. In particular, drawing attention to negative attributes first decreased participant choices of the vacation spot B whereas drawing attention to its
positive attributes first increased choice of vacation spot B, indicating that the
information was processed more actively than mere exposure would predict.

Order of attention (manipulated in Studies 1, 2 and 3) is important, but duration of
attention also matters, and studies have demonstrated that longer total duration of looking
at an option increases the likelihood of choosing it, both correlationally and
experimentally. In Study 1 we attempted to manipulate initial attention by directing
attention spatially. We found a left choice bias, indicating a bias of attention towards the
left of the display. While this left attention/choice bias has been shown in dichotomous
choice, with options displayed horizontally (e.g., Krajbich et al., 2010) there is also
evidence that, when faced with a horizontal array of many choices, a central gaze and
choice bias exists (Atalay et al., 2012; Shimojo et al. 2003). As such, when manipulating
initial attention, careful consideration of the visual display is necessary. There is also a
relationship between first fixation and total duration; what we look at first, we also
tend to look at for longer, and last, just prior to making a choice (Armel, Beaumel, & Rangel,
2008; Krajbich et al., 2010). In fact, it is possible that part of the effect seen in Study 1
(and possibly Study 3) is due to initial attention to an option increasing how long the
participant looks at it overall; further research will be required to test this possibility.

Such further testing may be quite fruitful because how long a patient attends to
information also has important implications when communicating treatment or screening
options to patients. For example, medical practitioners focus a great deal of time on
communicating treatment risks, and by comparison, much less time communicating the
benefits, perhaps assuming the benefits are obvious (for example, Terwin & Veitch,
2003). This is likely done in the interest of full disclosure so that the patient is fully
informed. However, the resulting disproportionate attention on risk information may lead
patients to place more (possibly too much) weight on them, and not enough weight on
benefits in their decisions. Thus, practitioners may want to consider how weighty they believe risks and benefits should be to a patient and adjust the amount of time spent in communications accordingly, in order to avoid the influence of erroneous effects of greater attention on one or the other. Ubel and colleagues (2010) found that providing contextual information (e.g., comparable health risks) eliminated some order effects in cancer treatment decisions. The unrelated risks put complex risk information into context, making it more evaluable and likely increasing the depth of its processing. Further research should examine the effects of contextual information on decisions where attention is manipulated.

Finally, in Studies 4 and 5, we used a font size manipulation to draw attention to numeric risk information. The manipulation increased participants’ sensitivity to risks as reflected in subsequent choices and valuation judgments. This font size manipulation has obvious implications in presenting treatment options (particularly if it is thought that patients neglect particular information to their own detriment). This technique also may be useful in highlighting the risks involved with negative health behaviors or the benefits that accrue from positive health behaviors in printed public health information.

In Studies 4 and 5, we argue that increased salience due to larger font size drew attention to the risk information. However, an alternate explanation for these results is that the larger font resulted in an implicit framing effect, conveying that information printed in the larger font was intended to be more important (Sher & McKenzie, 2006). Further examination of underlying processes is required to test these two different plausible accounts as well as others. Our current research, for example, does not include process data to examine directly the effects of spatial shifts of attention or attention due to information salience, but such future studies are needed.
In our studies, we used covert and overt manipulations of attention, but even our overt manipulations were subtle compared to what consumers face in many health-relevant purchase decisions. For example, unhealthy foods are frequently packaged in bright, eye catching colors and placed in areas intended to draw attention and increase consumption. Historically, tobacco products have also been packaged using vivid colors and attention grabbing mascots. Because of the negative health implications associated with increased consumption of such products, policy makers might consider regulating how corporations manipulate visual attention to their products through packaging and other marketing techniques. Some countries are beginning to do just this. Several countries have proposed plain tobacco packaging which would prohibit all forms of branding and would allow companies to place brand names on packages only in a standard font that is purposefully less salient than the mandated graphic warning labels. Australia is set to be the first country to implement this “generic” tobacco packaging in 2012 (Tobacco Plain Packaging Bill, 2011). A similar concept is already in place in Canada with respect to in-store shelf placement. Canadian tobacco packaging still contains brand information (colors, logos, etc.), but, in stores, tobacco products must be hidden from view and accessed only upon customer request (Health Canada, 2011). Policy makers are taking advantage of the adage “out of sight, out of mind” in an attempt to reduce consumption of, and harm from, tobacco products. The potential benefits of regulating attention are large for individuals and population health. In the USA, of course, these benefits must be weighed against potential costs such as the constitutional rights of companies selling products.
Conclusions

Attention is an important construct in decision making, but has been little examined in terms of its causal effects and potential moderators, particularly in health contexts. Attention manipulations provide an important and often overlooked tool for influencing healthier choices. Manipulations can influence what information or option is attended first and thereby receives disproportionate weight in choices. Or manipulations can highlight important information and allow for their greater depth of processing, providing an influence on both valuation and choice. Both methods can promote preventive health behaviors.
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