University of Pennsylvania

ScholarlyCommons

Joseph Wharton Scholars   Wharton Undergraduate Research

2020

The Effect of Celebrity Gaze-Cueing on Binary Choice Decision Making

Noah Werksman
University of Pennsylvania, werknoah@wharton.upenn.edu

Follow this and additional works at: https://repository.upenn.edu/joseph_wharton_scholars

The Effect of Celebrity Gaze-Cueing on Binary Choice Decision Making

Abstract

Marketers have long used celebrities in advertisements to help viewers build strong brand and product associations; however, it is not well understood how the celebrity and the visual context affect visual attention to and, ultimately, consumer decision making for the endorsed product. Most prior studies have focused on qualitative surveys about brand equity, memory of the advertisement, and self-reported interest and intent to purchase. My study uses new methods from applied neuroscience that allow me both to directly measure and to analyze how celebrities in static advertisements impact consumer decisions that do not require measures of verbal self-report.

Furthermore, research has shown that humans automatically divert their visual attention in the direction of another's gaze, known as "gaze-cueing" or "gaze-following" (Friesen and Kingstone, 1998; Kuhn and Kingstone, 2009). An overwhelming majority of celebrity endorsed advertisements depict celebrities looking at the viewer, not toward the endorsed product, though academic research suggests that gaze-cueing at the product (instead of toward the viewer) increases visual attention toward the endorsed product (Hutton and Nolte, 2011). My project tests whether the increase in visual attention due to gaze-cueing at the product translates into an increase in the consumer's subjective value of that product and consequently influences product choice. Results indicate that celebrity interventions in advertisements increased the subjective value of endorsed products yet, interestingly, did not drive more overt visual attention to them. Moreover, gaze-cueing was found to have a pronounced effect on guiding visual attention. These advertising cues impact choice, which could translate into larger profits for competitive consumer products.

Keywords

choice, decision-making, drift-diffusion, eye-tracking, decision neuroscience, perceptual choice, selective attention, gaze bias, preference bias, celebrity endorsed advertisements, gaze-cueing, gaze direction, celebrity endorsements, consumer behavior, visual marketing, social status

The Effect of Celebrity Gaze-Cueing on Binary Choice Decision Making

By

Noah Werksman

An Undergraduate Thesis submitted in partial fulfillment of the requirements for the

JOSEPH WHARTON SCHOLARS

Faculty Advisor:

Elizabeth Johnson, PhD

Executive Director, Wharton Neuroscience Initiative

THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA

MAY 2020

Acknowledgements

My advisor Elizabeth Johnson taught me everything I ought to know to write this paper. She also did all the behind-the-scenes work that might have scared me away from this foray into academia. I am extremely grateful for you, Zab! Thank you to Simone D'Ambrogio and Andrew Kaldas for being statistical stalwarts, and to Jessica Moh for her wizardry that created all the beautiful stimuli. And to my family and Maya, you sat with me for hours during the pandemic.

Abstract

Marketers have long used celebrities in advertisements to help viewers build strong brand and product associations. However, it is not well understood how the celebrity and the visual context affect visual attention to and, ultimately, consumer decision making for the endorsed product. Most prior studies have focused on qualitative surveys about brand equity, memory of the advertisement, and self-reported interest and intent to purchase. My study uses new methods from applied neuroscience that allow me both to directly measure and to analyze how celebrities in static advertisements impact consumer decisions that do not require measures of verbal self-report.

Furthermore, research has shown that humans automatically divert their visual attention in the direction of another's gaze, known as "gaze-cueing" or "gaze-following" (Friesen and Kingstone, 1998; Kuhn and Kingstone, 2009). An overwhelming majority of celebrity endorsed advertisements depict celebrities looking at the viewer, not toward the endorsed product, though academic research suggests that gaze-cueing at the product, rather than the viewer, increases visual attention toward the endorsed product (Hutton and Nolte, 2011). My project tests whether the increase in visual attention due to gaze-cueing at the product translates into an increase in the consumer's subjective value of that product and consequently influences product choice. Results indicate that celebrity interventions in advertisements increased the subjective value of endorsed products yet, interestingly, did not drive more overt visual attention to them. Moreover, gaze-cueing was found to have a pronounced effect on guiding visual attention. These advertising cues impact choice, which could translate into larger profits for competitive consumer products.

Introduction

Standard economic models of decision making assume that choices are guided by rational processes that maximize subjective utility (Kahneman et al., 1977). In the past few decades, work in behavioral and experimental economics has identified deviations from rational choice, which have led to new descriptive models that include limited information processing capacity, as well as biases in valuation and probability calculation (Rangel et al., 2008). The mechanisms underlying these processes remain unspecified in both traditional rational choice theory and behavioral economics. One key psychological process that seems likely to be involved is selective attention, which is a filter that biases limited computational capacities towards processing some sources of information over others—potentially accounting for classic phenomena like loss aversion (Schwartzstein, 2014).

Consistent with this idea, recent neuroscience research has uncovered the critical role that visual fixations play in the decision making process. These studies suggest that accumulator models, such as the drift-diffusion model (DDM), can quantitatively explain more complex relationships between choices and response times, provide running estimates of subjective value, and explain different decision biases for choice decisions guided by visual attention (aDDM; Krajbich et al., 2011). These models describe how consumers accumulate evidence during a visual back-and-forth comparison process until a decision threshold is met and a choice is made. Importantly, the models can yield quantitative measures during decisions that consumers often cannot report verbally.

I predict that a celebrity gaze-cueing at the product in an advertisement will amplify the subjective value of the endorsed products. In both humans and monkeys, higher-status individuals evoke more robust gaze-cueing than lower-status individuals (Liuzza et al., 2011).

This invites the possibility that celebrities may generate greater gaze-cueing effects on product choice than non-celebrities.

I.   Face Perception

A human's perception of celebrity in advertisements begins with visual processing of the face. Face perception as a means of species discrimination has been critical to "in-group" survival. Three-month-old human babies are able to detect the difference between human and gorilla faces, and infants continue to rely on facial recognition as the basis for human social cognition (Heron-Delaney, 2011; Parr, 2011). Moreover, humans have evolved a predisposition to perceiving information that may be inferred from another human's facial expression (Friesen and Kingstone, 1998; Kuhn and Kingstone, 2009; Keysers and Gazzola, 2007). Biological research has found that humans have neural receptors in the brain that enable this behavior. The superior temporal sulcus, which is responsible for processing facial expressions, is developed before most other parts of the brain (Tsao and Livingston, 2008). EEG and fMRI studies demonstrate that specialized areas of the brain, including the superior temporal sulcus, are activated by the observation of faces (Engell and Haxby, 2007; Hutton and Nolte, 2011; Itier and Batty, 2009). This helps explain why visual processing faces featured in images, movies, and artwork occurs automatically and seemingly instantaneously for most viewers, whereas the perception of other objects and features can require more time and attentional effort.

The human biological predisposition to face detection has significant implications for advertisers. Research has found that, on average, static advertisements featuring human faces outperform advertisements that do not (Russell and Rasolofoarison, 2017). The innate desire for social connection compels humans to relate more to, and, in turn, pay more attention to, media

that portray human faces. The pervasiveness of human faces in advertisements today testifies to the fact that marketers have long recognized the power of the human face, even without an understanding of the underlying psychobiology. Through visual manipulations, marketers use human faces to convey a variety of information meant to affect perception and consumer behavior.

II.   Gaze-Cueing Effect

Eyes are the most salient feature of the human face, and most relevant to facial identification (Karczmarek et al., 2016). The eyes have a unique capacity to convey identity, emotion and intent, in part explaining our natural tendency to look at another person's eyes before other parts of the body (Itier and Magali, 2009). Gaze direction, in particular, has a profound effect since it serves as the cue for a viewer's attention (see Figure 1) (Hungr and Hunt, 2012). Prior studies demonstrated that humans "rapidly and automatically" divert their visual attention in the direction of another's gaze (Friesen and Kingstone, 1998; Kuhn and Kingstone, 2009).
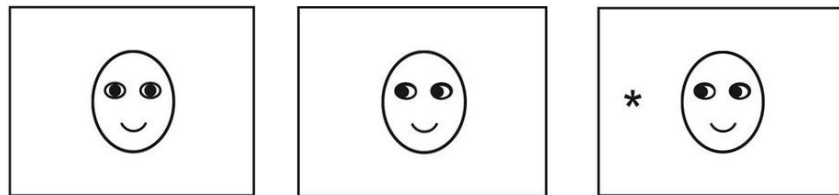

Figure 1. Gaze-cueing. The face in (A) exhibits direct gaze; (B) exhibits averted gaze; (C) exhibits averted gaze and gaze-cueing. (Source: researchgate.net)

Research suggests that gaze cues are more effective than arrows at directing a shift of attention, and it has been shown that infants as young as three-months-old follow eye gaze cues (Ricciardelli and Bricolo, 2002; Hood, Willen and Driver, 1998). Non-human primates are also capable of following eye gaze cues starting at an early age, padding the theory that this visual behavior has evolutionary, biological roots.

Similar to facial recognition, there exists specific brain regions responsible for gaze processing. Areas of the brain's fusiform gyrus, amygdala, and temporal sulcus display differential activity when a human observes averted or direct gaze (Senju and Johnson, 2009). A study conducted by Perrett et al. (1985) illustrated the existence of particular cells in a monkey's brain that are sensitive to the reception of gaze direction. The biological framework for the impact of gaze-cueing helps explain the amplitude of this type of stimulus.

However, not all gaze-cueing is equal. A study conducted by Hungr and Hunt (2012) showed how the more similar the cueing face is to that of the observer, the greater speed and more attention is paid to the intended target. Self-similarity, derived from a perception of "in-group" belonging, triggers acute neural responses that promote interest and trust in the cueing face. For example, social communication from family members, who on average look more like you, is more relevant than that from non-family members, who do not share the same defining visual characteristics. While self-similarity amplifies the gaze-cueing effect, researchers have found the same to be true of cueing faces that portray higher levels of subjective social dominance, generally, and cultural celebrities, more specifically. These modulating effects suggest that gaze-cueing is simultaneously both involuntary and volitional; observers reflexively and implicitly process the extent of their own social status relative to that of the cueing face to determine its meaningfulness before deciding to imitate its behavior. Non-human primates have also been found to exhibit this trait (Shephard et al., 2006). This phenomenon creates a dilemma in studying the gaze-cueing effect because these subjective judgements are made on an individual basis.

Many studies have simulated natural environments for studying the gaze-cueing effect. Hutton and Nolte (2011) asked participants to read an online magazine embedded with

advertisements that featured a model and a target product. They found that participants looked at product and brand regions for longer when the model was looking at the product rather than the viewer. Another study conducted by Sajjacholapunt and Ball (2014) showed that any gaze direction in general, as opposed to no face, increased dwell times on both the product and text in online advertisements; however, there was no significant difference between dwell times in the averted gaze or direct gaze conditions. While more current studies have explored other response variables such as brand recall and purchase intent, there lacks research on the effect of celebrity gaze direction and consumer decision making.

Employing the gaze-cueing effect is critical to the success of any advertisement that features a face. Not only does face presence increase an advertisement's effectiveness, but the product also receives more attention, better engagement and higher memory recall when gaze is aimed at the product (averted gaze) as opposed to directed at the viewer (direct gaze) (Adil and Lacoste-Badie, 2017). When the advertisement features an endorser looking at the product, a viewer is compelled to follow their gaze and focus on other areas of interest. However, when the advertisement features an endorser looking out of the frame, this may hinder learned associations and liking of the sponsored product.

On the basis of existing research on human visual processing, I hypothesize that inputting the attribute of celebrity in advertisements will amplify the gaze-cueing effect; increased recognizability of a celebrity will decrease the time spent by an observer on the celebrity's face and increase the amount of attention given to the endorsed product. Moreover, I hypothesize that a heightened level of trust through familiarity compels the viewer to more loyally follow the celebrity's gaze-cueing. Shepard et al.'s experiment, which studied how social dominance modulates the gaze-cueing effect, was conducted with non-human primates; my study aims to

replicate and further these results in human subjects to increase the applicability to human behavior and a marketing context.

III.   Gaze Cascade Effect

Simultaneous to the effect of gaze-cueing on visual attention is the effect that visual attention has on choice decision making, known as the *gaze cascade effect* (see Figure 2). It is well-known that we generally look at our ultimate choice object, as this facilitates visual-motor outputs, such as reaching, but choice decisions are also mediated by gaze bias, which operates in a feedback loop with pre-existing value-based preferences (Simion and Shimojo, 2007). In other words, pre-existing value-based

Figure 2. Illustration of Gaze-Cascade Effect. The probability of gazing at a chosen item increases as the decision time nears. (Source: Simion and Shimojo, 2007)

preferences are not the primary driver of choice decision making. Research has found that even when controlling for pre-existing preferences, individuals most likely choose the item they gaze at the longest (Krajbich et al., 2010).

For example, the longer I gaze at a bag of Cheetos in the snack aisle, the more I prefer and gaze at them, and consequently the more likely I am to choose the bag of Cheetos among other snack options. If I never saw the Cheetos, there is little to no chance I might buy them; however, if my pre-existing preferences lean toward Cheetos, then I will be inclined to find and gaze at them longer. The stronger my value-based preference is for Cheetos, the shorter period of
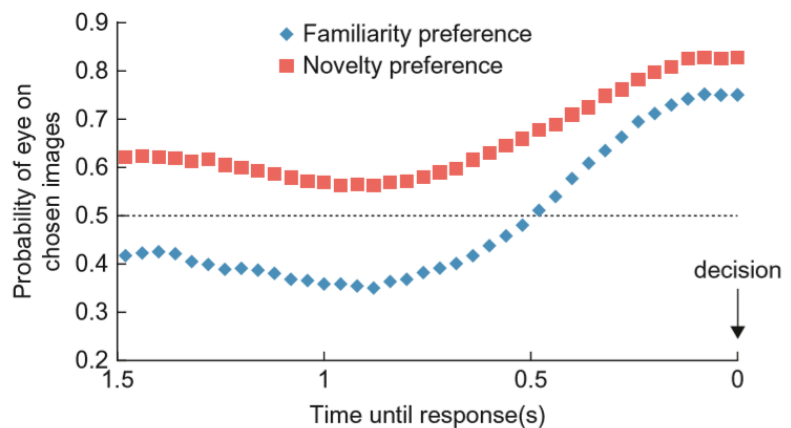
time I need to spend gazing at them before I choose among alternatives; similarly, the more ambiguous my value-based preferences are for the array of snack foods in the snack aisle, the longer it will take me to decide. The choice decision making process will take longer because I will disperse more of my gaze time across the alternatives, which entails gazing at each individual snack food for a shorter period of time. In this fragmented process it will take me longer to accumulate enough noisy evidence that will help me reach a decision threshold, but as I accumulate evidence by gazing at each of the two options, I increase my preference for the one I look at longer, which eventually guides my ultimate choice. In all, my value-based preference is informed by my gaze behavior, which is most directly responsible for the choice. Research dictates that I will spend the final moments of the decision making process gazing at the item I will eventually choose.

IV.   Celebrity-Brand Associations

A celebrity is a famous individual who uses their own recognition for financial gain. Marketers increasingly rely on celebrities as marketing props, as roughly a fourth of all advertisements feature a famous endorser and corporations worldwide fuel the industry with an estimated $5+ billion annually (Ding et al., 2010). While these investments should be justified by a substantial return, the science is still mixed as to the superior value of celebrity endorsers (Harrington, 2014).

The most recognized model for understanding the purpose of celebrities in advertisements is McCraken's Meaning Transfer Model (MTM). The MTM articulates a three-phase scheme in which there is fluid transfer of meaning among the celebrity, consumer and product at equilibrium (Figure 3), and it grew out of previous models to account for the more "mobile quality" of a modern consumer society. In the MTM, celebrities serve to bridge the gap between products and a "culturally constituted world" (McCraken, 1986). This principle constitutes the first phase. In the second phase, celebrities transfer meaning to the product; it is the job of the advertiser to pair the product with the appropriate celebrity such that the relationship brings to light the product's most appealing attributes. The final phase incorporates a transference of this new meaning to the consumers, whether through advertising, art or other forms of
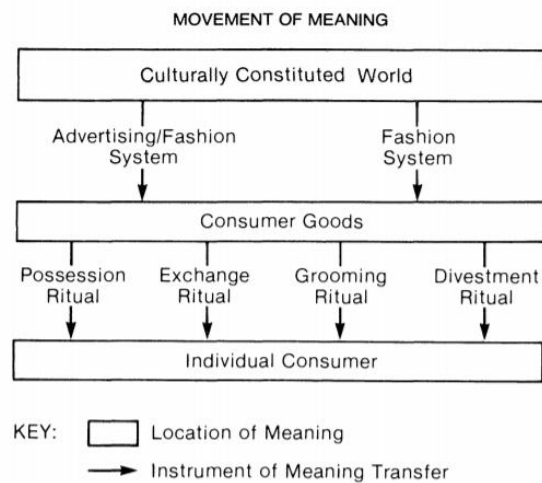

Figure 3. MTM Hierarchy.
(Source: McCraken, 1986)

cultural expression. The MTM will help us understand how the perception of celebrity in static advertisements translates into consumer responses; however, the transference of meaning might be compromised by what is known as the "vampire effect". The vampire effect describes how the celebrity's own recognizability and popularity overwhelm attention to and recall of the endorsed product (Erfgen and Zenker, 2012). This variable is difficult to measure; however, the presence of its effect is often evident when increased visual attention paid to the celebrity endorser rather than the product still increases choice preference for that product.

V.   Drift-Diffusion Model

My experiment applies the drift-diffusion model (DDM) to simple binary choice decision

making (see Figure 4). The DDM is a computational model that provides quantitative

explanations for perceptual choices, and is built on the theory that individuals accumulate noisy,

stochastic evidence that is used to make a preference-based decision. This noise comes in two

forms: one intrinsic to the item's attributes, the other due to random shifts in attention between

items. The longer an individual views
an item (perceptual choice), the more
evidence they acquire through top-
down sensory processing that leads
them to a decision in favor of that
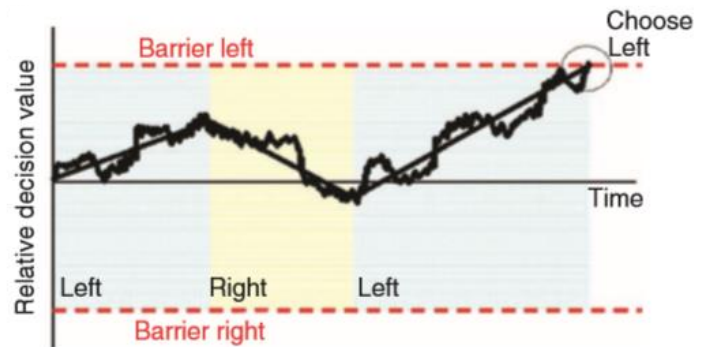item. Research has shown that, in

Figure 4. Example of DDM Graph.
(Source: Krajbich et al., 2012)

simple binary choice decision making, an individual accumulates only a third as much

information about an item when they are not looking at it (Krajbich et al., 2012). The DDM

discounts preference bias in order to capture a better estimate of the non-decision time spent

accumulating noisy evidence of the set of items.

The "drift rate" captures the speed at which this evidence is accumulated as a function of

shifts in visual attention and the reaction time of the decision; a high drift rate indicates that the

decision is easier to make and more accurate to indications of preference. Likewise, the relative

decision value (RDV) attempts to represent how close an individual is to reaching the decision

threshold at a given moment in time (Krajbich and Armel, 2011; Krajbich et al., 2012).

The eye-tracking hardware attached to the computer monitor tracks gaze patterns that are

applied to the experimental trial post hoc and can extend the classic DDM with an attentional

measure (gaze), and is thus called the aDDM ('a' for "attentional"). The HDDM ('H' for "hierarchical") is useful for this study because it requires fewer data per subject/condition than non-hierarchical drift-diffusion methods. It uses a hierarchical Bayesian parameter estimation, which is useful for enhancing statistical power; this provides simultaneous estimation of individual parameters and the group distribution from which the parameters are drawn, while also providing estimates of the posterior distribution. In addition, toolboxes for HDDM applications for complex datasets are readily available (Wiecki, Sofer & Frank, 2013). In our experiment, we needed a robust method that could analyze choice decision categories by many distinct conditions, including endorser type and their gaze direction.

While scientists have studied a vast array of manipulations on choice decisions, Philiastides and Ratcliff (2012) is the only study that has explored the effect of branding on decision making by also analyzing it according to the DDM. These researchers found that items branded with labels were chosen more often than those without labels, and that items branded with labels produced higher drift rates. Lastly, there was a strong interaction between preference for the label and preference for the item; when the difference in preference between label and item was high, reaction times increased because the decision became more difficult. Branding not only produced higher drift rates but also affected the drift rate itself. My study aims to apply these novel methodologies and analyses to another complex yet real-world marketing intervention, celebrity endorsed advertisements.

Data and Methods

a. Participants

77 healthy adults (54 females, 23 males) ages 18 to 72 years (age $\mu = 27$, $\sigma = 12$) with normal or correct-to-normal vision volunteered to participate in this study. Three subjects were excluded from subsequent analysis due to mis-calibration of the eye-tracker and technical malfunctions, and the results of the remaining 74 subjects (52 women, 22 men, age $\mu = 26$) were included in analysis. The research protocol and informed consent forms were approved by the Institutional Review Board of the University of Pennsylvania.

b. Experimental Design

Subjects performed four tasks during an eye-tracking experiment (see Figure 5). **Task 1)** Participants saw high resolution pictures of two common snack food options and were free to look at each option as much and for as long as they wanted before they indicated their choice with a key press. The choice set consisted of 15 distinct snack foods for a total of 105 unique choice pairings. I measured gaze using eye-tracking, choice decisions and response times.

Task 2) Participants then viewed a series of 15 static mock advertisements each presented for 4 seconds: 6 were advertisements featuring a celebrity, 3 gazing toward a snack food and 3 gazing at the viewer (See Figures 6a-f for examples), 6 were advertisements featuring a non-celebrity (unrecognizable, though still attractive) model, 3 gazing toward the snack food and 3 gazing at the viewer (See Figures 6g-l for examples),

and 3 contained only snack foods on a colored background (See Figures 6m-o for examples). This portion of the study only measured eye tracking.

Task 3) Participants then repeated Task 1 (105 unique snack food choice pairs). I instructed participants that Task 3 was not a memory task, thus unnecessary to remember their previous decisions and behaviors from Task 1. I measured gaze, choice decisions and response times again.

Task 4) Participants completed a brief demographic survey. I welcomed the participants to take one snack food for free upon their exit from the laboratory and recorded the taken product.

Figure 5.
Eye-tracking Task Flow.
After making 105 snack food pair choices, each of 15 ads appears for 4 seconds. The first task is then repeated.

(x 105)

2 sec

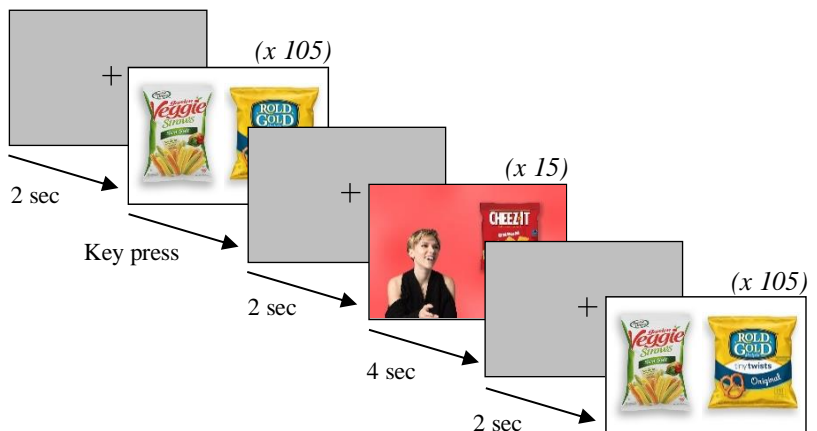Key press

(x 15)

2 sec

4 sec

(x 105)

2 sec

Figure 6. Task 2 Images.

Figures 6a-c are ads featuring celebrities with direct gaze;
Figures 6d-f are ads featuring celebrities with averted gaze;
Figures 6g-i are ads featuring non-celebrities with direct gaze;
Figures 6j-l are ads featuring non-celebrities with averted gaze;
Figures 6m-o are snack food portraits.

Figure 6a. Kim Kardashian

Figure 6b. Selena Gomez

Figure 6c. John Legend

Figure 6d. Scarlett Johansson

Figure 6e. Snoop Dogg

Figure 6f. David Beckham

Figure 6g. Non-celebrity model

Figure 6h. Non-celebrity model

Figure 6i. Non-celebrity model

Figure 6j. Non-celebrity model

Figure 6k. Non-celebrity model

Figure 6l. Non-celebrity model

Figure 6m. Snack Food Portrait

Figure 6n. Snack Food Portrait

Figure 6o. Snack Food Portrait

The study was administered on two Dell desktop computers at individual workstations in the Wharton Behavioral Lab paired with SMI RedM below the screen-mounted eye trackers. Participants were seated approximately 55-65 cm from a 19'' Dell Ultrasharp LCD monitor. All images presented were 1280x1024 pixels and filled the screen. The surveys were created and administered on Qualtrics, and the stimuli were displayed using custom Python scripts executed in PsychoPy (Pierce et al., 2019). The corresponding keyboard presses and reaction times were recorded using PsychoPy. Participants were compensated $10 for one hour.

c. Celebrity and Snack Food Experimental Design

I paired celebrities with snack foods that feasibly establishes congruence and cognitive links. My choice of snack foods in particular was deliberate because the food category generally lacks associations with celebrities. This is corroborated by the fact that I found no instance in which one of the 15 selected snack foods is featured in a celebrity endorsed advertisement.

For my experiment, I selected celebrities using the same subjective standards as I did selecting snack foods. I picked 6 celebrities who all possess an ostensibly equal level of attractiveness, popularity and reputation, yet a diversity in gender, industry and race. This quality measure aims to control for instances of overshadowing while respectfully accommodating for the diversity of my experiment's participants.

d. Eye-Tracking Experimental Design

Eye-tracking data was collected using a SMI RedM eye-tracking system that is mounted to the base of the desktop monitor. The eye-tracking system is completely non-invasive, with no need to artificially constrain head or body movements. The eye tracker was calibrated for each participant using a 5-point calibration, whereby each participant followed the location of a moving dot appearing at predetermined locations around the screen. The eye tracker collects data at 120Hz on gaze location expressed in screen coordinates.

The SMI RedM eye tracker processes gaze patterns in both samples and events. Samples consist of data in its rawest form as recorded at the processing frequency of the eye tracker; the SMI RedM produces 120 gaze coordinates per second. Events consist of

coordinates consolidated by user events, which are fixations, saccades and blinks. The

eye tracker is preprogrammed to identify these events by perceiving changes in the level

of infrared light that is reflected from the cornea and pupil. The duration of these user

events determines the number of gaze coordinates produced by the eye tracker.

e. Analysis

For all eye-tracking data, I chose to exclusively analyze the event data because its

organization facilitates a more accurate analysis of gaze patterns. This study is primarily

interested in dwell times, which describe the cumulative duration of fixations that occur

within a predetermined AOI, and saccadic trajectories, which describe the eye's rapid

movement between these fixations. In Tasks 1 and 3, the AOI was the snack food in both

portraits of each pair; in Task 2, the AOIs were the endorser's face, the snack food

product and the snack food product logo. I used imaging software in Adobe Photoshop to

determine the four-point coordinate boundaries of these AOIs. I used R Studio to compile

and clean all event data. I kept only the duration and coordinate values of fixations that

occurred within the three specified AOIs, and subsequently grouped all fixations by AOI

by participant. Once the eye tracking data was cleaned, I compiled it with the survey and

keyboard response data.

I used JMP to perform the advertisement analysis of Task 2 and used R to

perform the choice pair and HDDM analyses of Tasks 1 and 3. The real snack food exit

choice data of Task 4 was analyzed with the choice pair data of Tasks 1 and 3 in Excel.

Advertisement Analysis in JMP

I ran two mixed model regressions to understand what fixed and random variables had a statistically significant effect on 1) dwell times and 2) saccadic trajectories, as grouped by the advertisement's AOIs. Among the fixed effect variables, both regressions included three nominal variables: endorser type, gaze direction and the endorser's gender. The first regression also included one continuous variable: pixel size of AOI. The pixel size of an AOI is less relevant in understanding visual movements between AOIs than time spent looking at an AOI. The random effect variable was the participant identifier number. Subsequently, I ran post hoc *t* tests to isolate the effect of predictor variables.

Choice Pair Analysis in R

I ran a sequential sample model to calculate the subjective and relative value (SV" and RV, respectively) of each product and choice pair by participant in Tasks 1 and 3. The SV was calculated by summing the number of times each product was chosen; the RV of each choice pair is determined by calculating the difference between the SV of the two products This discrete value ranges from '0' to '15' ('0' indicates minimum preference, '15' indicates maximum preference). This approach is more appropriate than other traditional proxies that are determined by the participant, such as willingness-to-pay or rank order, because there are relatively small discrete value differences within the product category. A more relative point system is more suitable for this study's purposes.

Next I ran a series of mixed model logistic regressions to determine how choices were individually and collectively affected by: preference bias, participant gaze bias, endorser type, gaze direction, and gender. The first regression aimed to determine both

whether preferences in Task 1, as dictated by RV, predict choices in Task 3, and whether advertising a product with a celebrity in Task 2 increased preference for that product in Task 3. The interaction between RV and the endorser type are important in telling us whether celebrity interventions across varying degrees of preference bias influence our choice decisions in Task 3. Among the fixed effect variables were: 1) Nominal (whether one of the images in a choice pair features a celebrity; choice pairs that do not meet this condition were excluded), and 2) Continuous (the RV of choices in Task 1 and the interaction between RV of choices in Task 1 and the aforementioned nominal celebrity variable). The random effect variable was the participant identifier number.

The second regression aimed to help determine whether participant gaze bias, in addition to the variables of the first model, influenced choice. This test focused on whether gaze bias toward a product in a choice pair increased the likelihood of choosing that product. Gaze bias represents the proportion of time a participant spends looking at a particular product in a choice pair (PT).

The third regression focused on how changes in gaze patterns and reaction times explain *changes* in choice. This analysis highlights the probability that a difference in time spent gazing at a chosen product is an indicator that the observer's decision about that choice might change. Among the fixed effect variables were three continuous variables: reaction time (RT) in Task 1, |RV| in Task 1, and the change in PT between Tasks 1 and 3. The logistic response variable is a binary indicator of whether the participant changed their choice decision between the same choice pairs of Tasks 1 and 3.

Lastly, the fourth and fifth regressions explore the various celebrity gaze-cueing conditions on choice. The fourth analyzes endorser type and gaze direction in only one

product of each choice pair, and toggles with the effect that RV has on the probability of changing choice. The fifth accommodates manipulations of both product across choice pairs, which allows for a more comprehensive interpretation of the various manipulations. This tests address our primary hypothesis that the perception of celebrity amplifies the effect of gaze-cueing on choice.

HDDM Analysis in R

I also ran an HDDM on the choice pair data of Tasks 1 and 3 to calculate the drift rate distribution means of products grouped by endorser type and gaze direction. This analysis helps us understand the top-down sensory processing that occurs when the participants make their choices. Task 1 provides a baseline for us to understand how the advertisement interventions in Task 2 affected the subjective value of products in repeated Task 3. Variations in gaze patterns, reaction times and choice decisions are factored into the drift rate, which summarizes to what extent the celebrity gaze-cueing conditions increased the subjective value of the associated products.

Real Food Exit Choice Analysis in Excel

Three participants were excluded from the subsequent analysis because they opted out of choosing a real snack in Task 4, therefore the results of the remaining 71 participants were included in this analysis (51 women, 20 men, age $\mu = 25$). I ran a series of exploratory distributions to examine how the subjective value of a product, as expressed in the binary choice decisions of Tasks 1 and 3, translates into the probability of selecting that product in Task 4. I assigned three levels of preference to the subjective

value: "low" (1-5), "medium" (6-10) and "high" (11-15). This distribution allowed me to better study those participants who chose snack products with low or medium preference; furthermore, the type of interventions in Task 2 associated with the selected snack products might help explain a deviation from choosing those that are highly preferred.

Results

A. Advertisement Analysis

Results indicated that the perception of celebrity did not significantly increase dwell time on the face, snack or logo AOIs, although it was statistically significant in driving visits toward the face ($F = 4.22$, $p < .05$). Meanwhile, celebrity and non-celebrity endorsers gazing at the viewer increased dwell time on the face and visits toward the product (($F = 12.75$, $p < .01$) and ($F = 4.00$, $p < .05$), respectively). Lastly, the pixel size of AOIs and the gender of the endorser significantly affected dwell times across AOIs (($F = 44.30$, $p < .01$) and ($F = 10.32$, $p < .01$), respectively).

Post hoc *t* tests helped us better isolate the independent effects of celebrity, gaze-cueing and the endorser's gender. In general, non-celebrities drove higher dwell times on the product than celebrities; when non-celebrities were gazing at the product, participants dwelled on and visited the product significantly more than the face (($\mu = 1.56$, $\sigma = .08$) and ($\mu = .16$, $\sigma = .07$), respectively). Regardless of the endorser type, gaze-cueing toward the product increased dwell time on the product (see Table 1) ($\mu = .17$, $\sigma = .05$).

As it relates to the endorser's gender, another *t* test revealed that when the endorser was male, participants dwelled more on the snack than the face but visited the face moderately more than the snack ($\mu = .09$, $\sigma = .05$). Conversely, when the endorser was female, participants

dwelled more on the face but visited the snack more often (see Figure 7) (($\mu = .22$, $\sigma = .06$) and ($\mu = .15$, $\sigma = .05$), respectively).

B. Choice Pair Analysis

The first regression indicated that celebrity, preference bias, and the interaction between celebrity and preference bias significantly affected choice decisions, while participant gaze bias toward the chosen product showed a modest yet insignificant effect (($F = 28.76$, $p < .01$), ($F = 2.62$, $p < .01$) and ($F = 5.02$, $p < .01$), respectively). Celebrity endorsed products were chosen more often than those not endorsed by a celebrity (see Figure 8), while choices are less likely to change as preference bias increases (see Figure 12). The interaction between the two variables is significant: celebrity endorsed products are chosen more often when preference bias is near neutral, although this relationship weakens as preference bias increases (see Figure 10).

The second and third tests confirmed the impact of gaze-cueing, reaction time and changes in dwell time on choice decisions. Products associated with an endorser gazing at it were chosen more often than those unendorsed or wherein the endorser is gazing at the viewer (see Figure 9) (($\mu = .74$, $\sigma = .14$) and ($\mu = .78$, $\sigma = .12$), respectively). Results also found that reaction time for and dwell time on the chosen snack was significant in changing choices when accounting for preference bias (see Figure 11) (($\mu = 1.15$, $\sigma = .08$) and ($\mu = 3.32$, $\sigma = .98$), respectively).

When excluding for preference bias, the fourth test found that endorsed products were chosen more often than unendorsed products in general, and celebrity endorsed products were chosen more often than non-celebrity endorsed products specifically (see Figure 14) ($p < .05$). Moreover, participant gaze bias was a significant predictor, and many participant gender effects

were observed. Males more often than females chose products endorsed by a non-celebrity (see Figure 13) ($F = 2.05$, $p < .05$). When accounting for preference bias, no significant gender effects were observed, participant gaze bias became insignificant and celebrity endorsed products were only chosen more often than products wherein a non-celebrity endorser is gazing at the viewer (see Figures 14 and 15 for a comparison) ($p < .01$).

The fifth regression found that choices were less affected by celebrity and gaze-cueing when accounting for preference bias as well as the manipulation of both products in Task 2. Participants were more likely to select a product when the celebrity was gazing at the product rather than at the viewer ($F = .38$, $p < .01$). Where non-celebrity endorsements are concerned, participants were more likely to choose the product wherein the non-celebrity endorser is gazing at the viewer than in the following conditions: 1) unendorsed products, 2) non-celebrity endorser gazing at the product, and 3) celebrity endorser gazing at the viewer (($F = .60$, $p < .05$), ($F = .58$, $p < .05$) and ($F = .39$, $p < .01$) and, respectively).

C. HDDM Analysis

The HDDM found that the drift rate distribution mean of products associated with a celebrity endorser gazing at it was higher than that of all other products ($p < .05$). The drift rate distribution mean of products endorsed by celebrities was moderately higher than those of products endorsed by non-celebrities (see Figure 17). In sum, the perception of celebrity increased the subjective value of endorsed products in general, as celebrity gaze-cueing at the product increased the subjective value of endorsed products the most.

D. Real Food Exit Choice Analysis

A strong majority of participants selected to take a real snack food in Task 4 for which they indicated "high" preference in Task 3 ($n = 55$), while few selected real snack foods for which they indicated "medium" ($n = 12$) or "low" ($n = 4$) preference (77, 17 and 6 percent, respectively). Figure 16 illustrates this distribution. Of the 12 "medium" preference selections, the average subjective value was marginally close to being considered "high" preference ($\mu = 9.25$, $\sigma = .92$). Among the collective 16 "medium" and "low" preference selections, 8 picked snack foods associated with a celebrity endorser, 6 picked snack foods associated with a non-celebrity endorser, and 2 picked unendorsed snack foods (50, 38 and 12 percent, respectively).

While there is some variation between preference and real snack food selection, there is less variation between preferences (as measured by subjective value) recorded in Tasks 1 and 3 for the real snack food chosen in Task 4 ($\mu = .15$, $\sigma = 1.30$). Moreover, 83 percent of participants exhibited no change in preference according to the assigned preference thresholds. The difference among the low, medium and high preference groups is negligent.

Table 1. Dwell Time by Endorser Type and Gaze Direction.

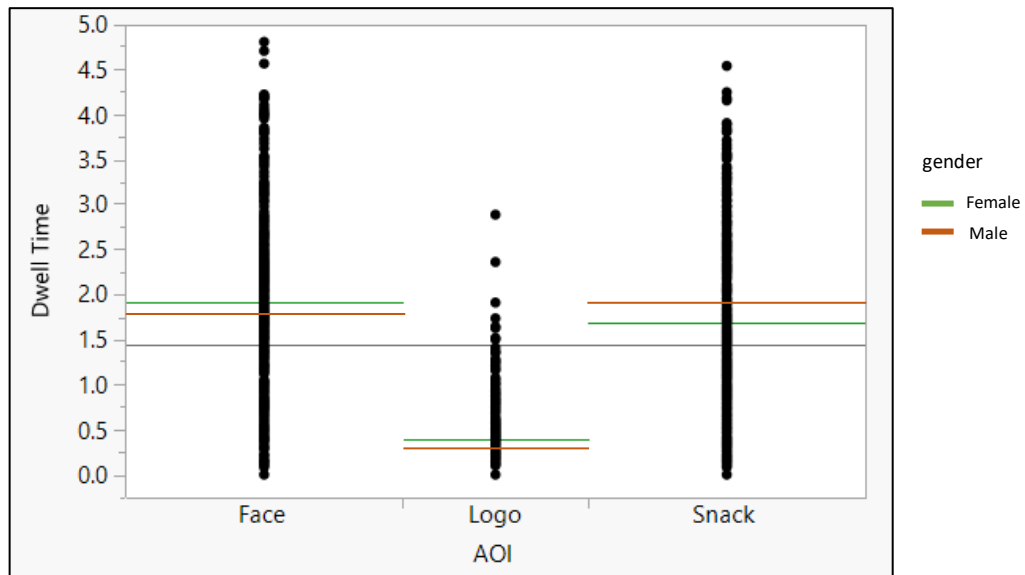|	Proportion of Time Viewing Product	Proportion of Time Viewing Face	SE
Average	.45	.46	.99
CP	.46	.44	.06
CV	.40	.44	.07
NP	.49	.42	.06
NV	.42	.53	.07

Figure 7. Dwell Time on AOIs by Gender.
The face was viewed more than the product when the endorser was female
($\mu = .22$, $\sigma = .06$). However, when the endorser was male, the product was
viewed more than the face ($\mu = .10$, $\sigma = .06$).

Which Image in Task 3 Choice Pairs Featured in Celebrity Endorsed Ad.
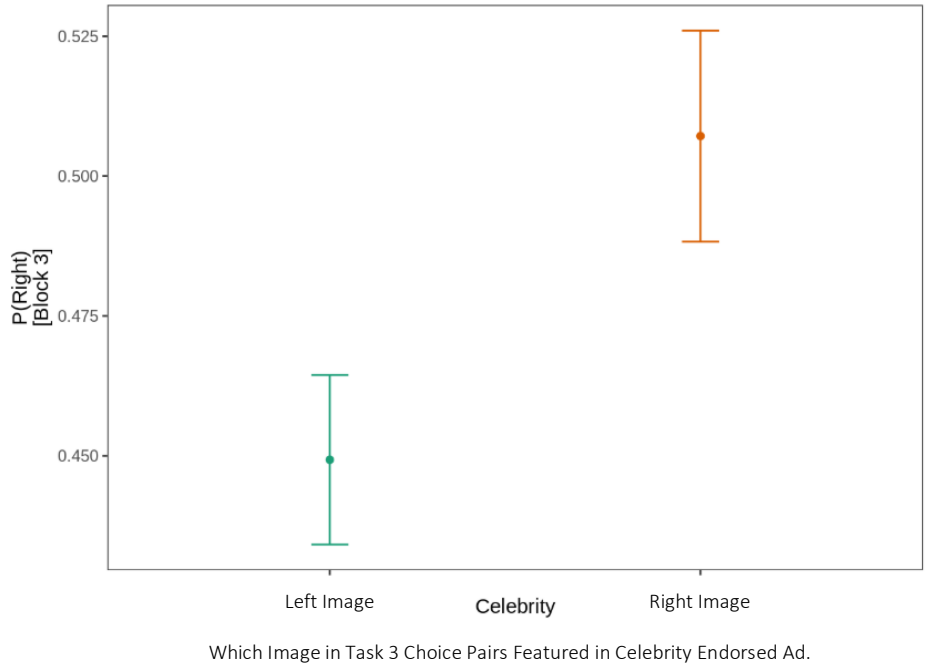
Figure 8. Probability of Choosing the Celebrity Endorsed Product.
Celebrity endorsed products are chosen more often than those products
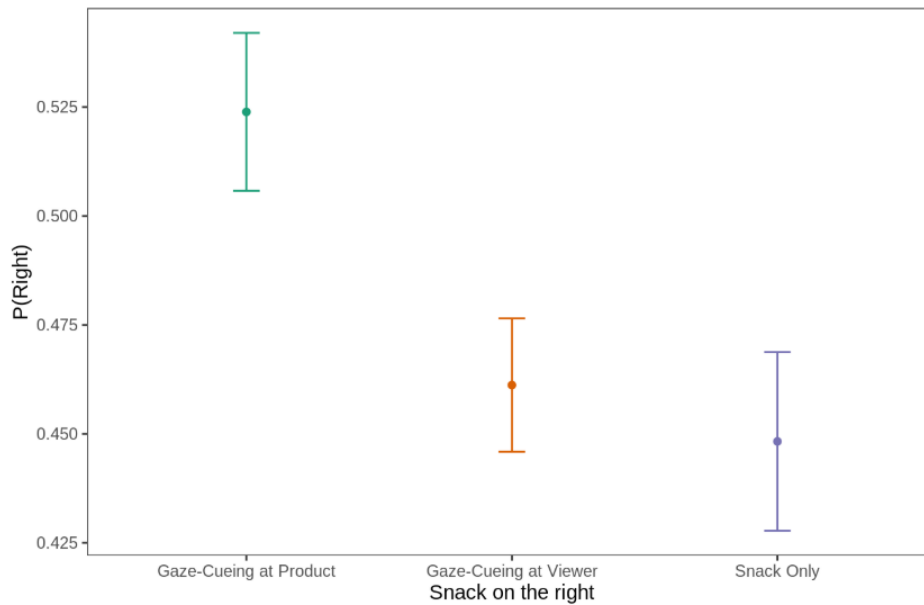not celebrity endorsed ($\mu = .54$, $\sigma = .02$).

Figure 9. Probability of Choosing the "Gazed At" Product.
Participants more often chose the product associated with the endorser
gazing at it than those unendorsed and associated with endorsers gazing
at the viewer (($\mu = .78$, $\sigma = .12$) and ($\mu = .74$, $\sigma = .15$), respectively).
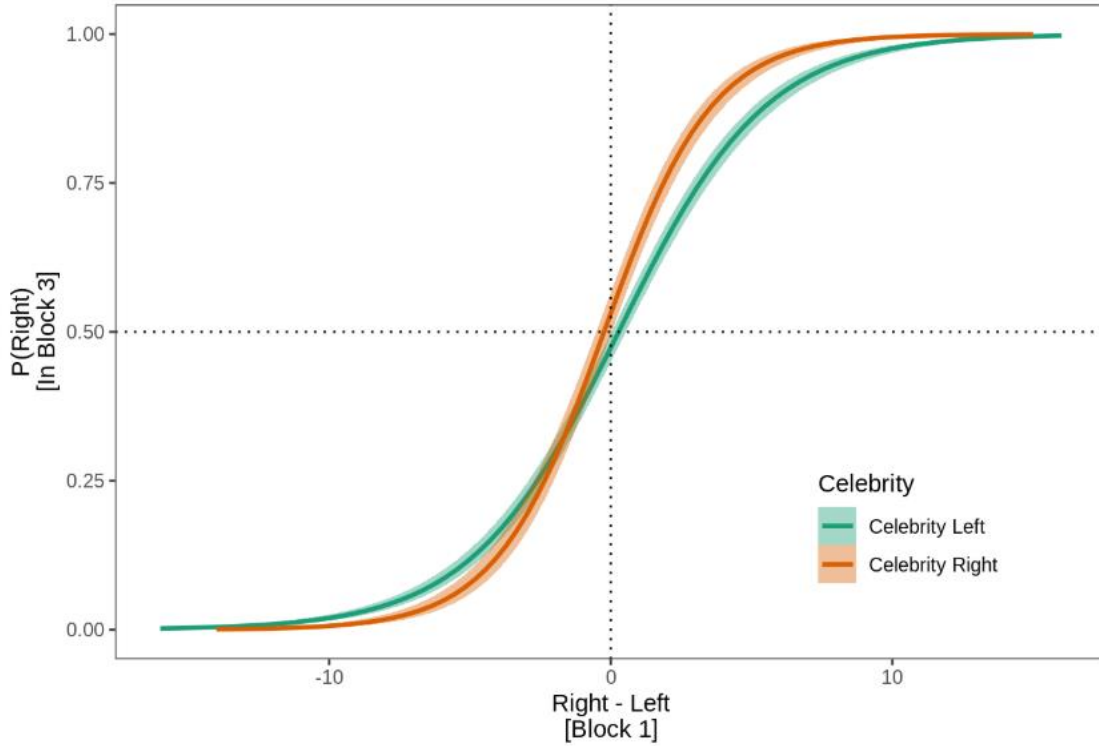
Figure 10. Changing Choice by Celebrity and Preference.
When preference bias is near neutral, celebrity endorsed products are chosen more often ($\mu = 1.15$, $\sigma = .06$). This relationship weakens as preference bias increases.
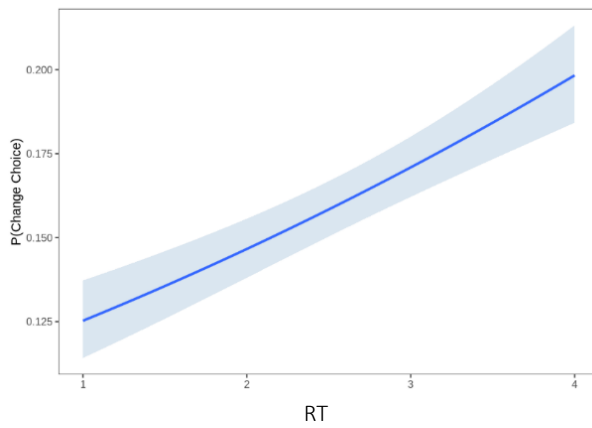

Figure 11. Changing Choice by Reaction Time.
Choices change more often as the reaction time increases ($\mu = 1.15$, $\sigma = .02$).
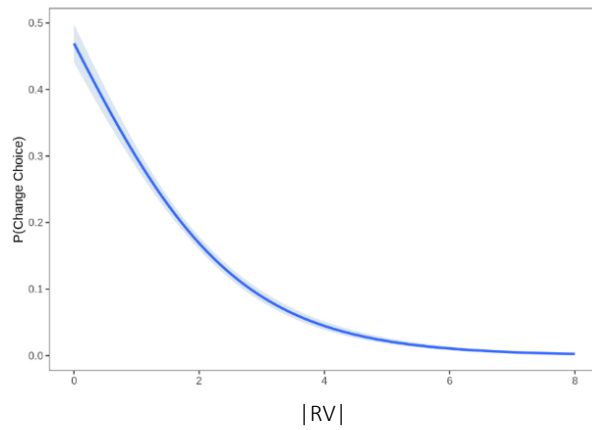

Figure 12. Changing Choice by Relative Value.
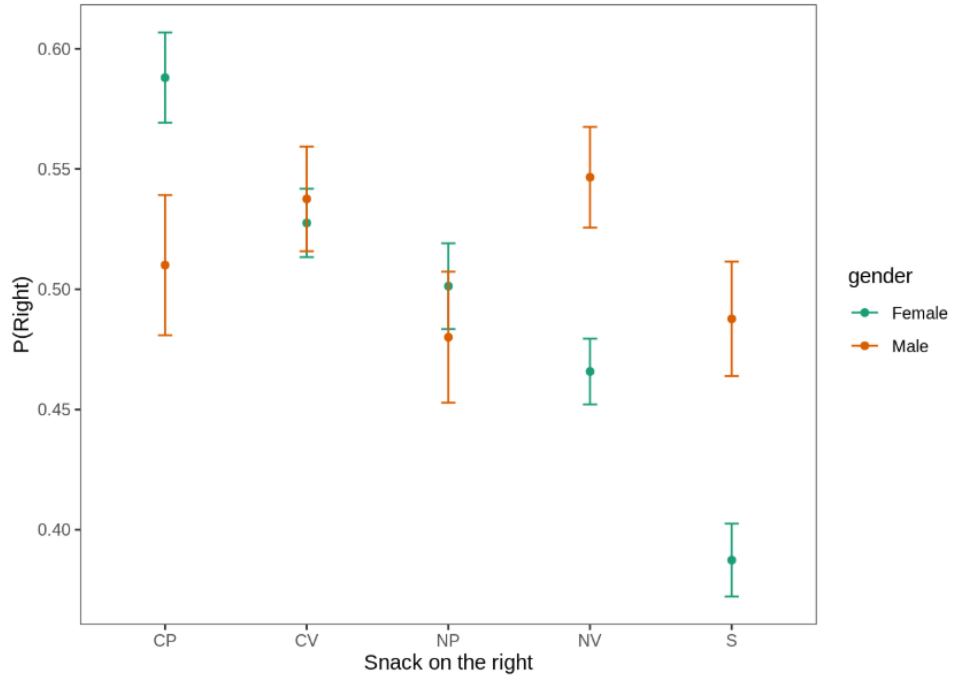Choices change less often as preference bias increases ($\mu = .48$, $\sigma = .03$).

Figure 13. Choice by Gender, Celebrity Gaze-Cueing.
Excl. preference, females more often than males chose a product
endorsed by a celebrity gazing at it ($p < .05$). Females are generally
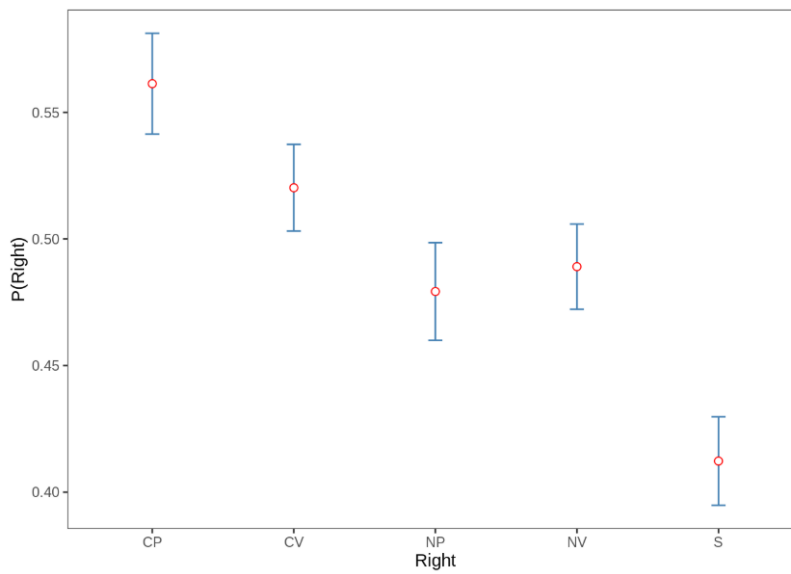more responsive than males to endorsement and endorser type.

Figure 14. Choice by Celebrity Gaze-Cueing, excl. Preference.
Products endorsed by a celebrity gazing at it are chosen more often
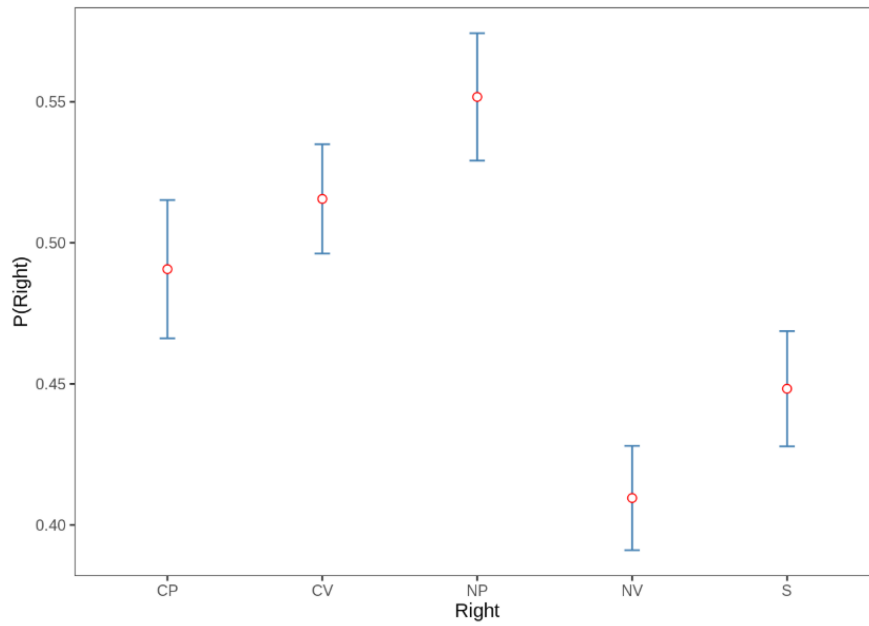than those unendorsed and non-celebrity endorsed ($p < .05$).

Figure 15. Choice by Celebrity Gaze-Cueing, with Preference.
Generally, celebrity endorsed products are chosen more often than those
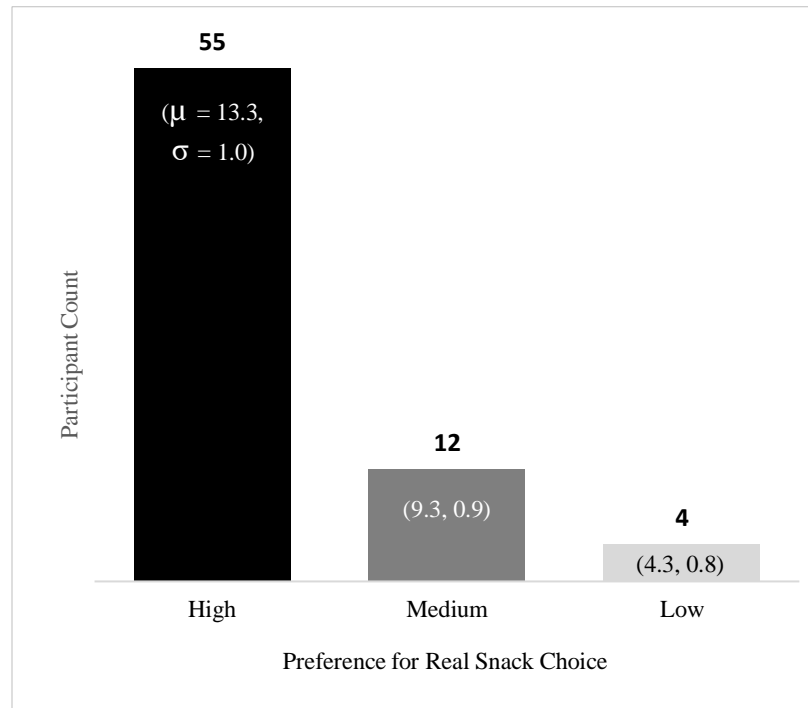unendorsed and associated with a non-celebrity gazing at the viewer.

Figure 16. Preference Frequency of Real Snack Food Choice.
A strong majority (77 percent) of participants chose real snack foods
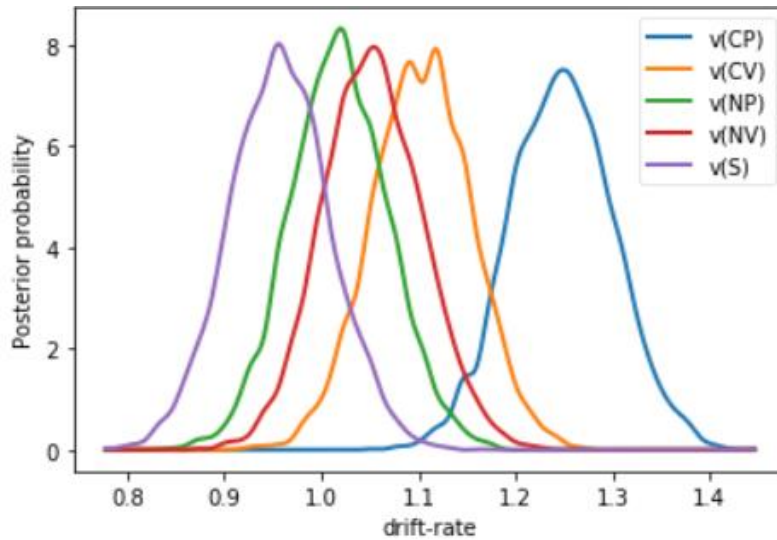in Task 4 for which they indicated high preference in Task 3.

Figure 17. Drift Rate Distributions by Celebrity Gaze-Cueing.
The drift rate distribution mean of products endorsed by celebrities gazing at it is higher than that of all other products ($p < .05$). Generally, the drift rate mean of products endorsed by a celebrity is modestly higher than that of products endorsed by a non-celebrity.

Discussion

This study suggests that social status and joint attention have a major impact on visual behavior and subsequent choice decisions. Figure 8 illustrates how celebrity endorsed products were chosen more often than both non-celebrity endorsed and unendorsed products, and Figure 9 shows that those products associated with the endorser gazing at it were chosen more often than both unendorsed products and those products associated with endorsers gazing at the viewer. In addition to the strength of their independent effects, Figure 14 shows how celebrity in general, and celebrity gaze-cueing specifically, drove product choice when excluding for preference bias.

The higher drift rate distribution means of the celebrity and celebrity gaze-cueing conditions, as observed in Figure 17, can help explain the increase in choice decisions of the associated products. Participants easily processed a celebrity's recognizability and popularity as

well as the transference of these qualities to the product. This increased the product's perceived value when participants made their subsequent choice decisions.

The effect of non-celebrity endorsements is more varied. The drift rate distribution mean of products associated with a non-celebrity endorser looking at the *viewer* is modestly higher than when the endorser is gazing at the product. The lack of recognizability and popularity of non-celebrities in general diminishes the value transferred from endorser to product. Less information is available to the viewer and therefore the relationship between endorser and product may be more tenuous in the mind of the viewer. A non-celebrity gazing at the viewer may provide relatively more information and may be marginally easier to process than a non-celebrity gazing at the product. When information is already scarce, a non-celebrity's direct gaze may create a stronger cognitive link between viewer and endorser that facilitates favorable choice decisions. In this way, the ease of evidence accumulation mediates the effect of gaze-cueing on the perception of celebrity.

The visual behavior of participants aligns with the influence of the various celebrity gaze-cueing conditions on choice. Table 1 shows that the product received more attention when the endorser is gazing at it as opposed to the viewer, and this visual relationship may establish the cognitive links requisite for making choices in favor of that product. However, Table 1 also shows how non-celebrity endorsers drive more attention to the product than celebrity endorsers, on average. This finding might be justified by the vampire effect, which may explain why participants spent longer looking at features of the endorser in the case of celebrities rather than following their gaze cues (Erfgen and Zenker, 2012). The familiarity and intrigue of celebrities is likely much more captivating than unrecognizable non-celebrities, who due to their unfamiliarity compel viewers to dwell on features of the products.

Regardless, the perception of celebrity is less salient and relevant to visual processing than the endorser's gaze direction or other elements of an advertisement's visual context. Although subjects spent longer looking at the celebrity endorser than the product, this might translate into the perception of stronger celebrity-brand associations that are more of a factor in choice decisions. The finding that gaze bias was insignificant in affecting choice further suggests that an individual's visual behavior may be less significant than cognitive processes, such as preference or "celebrity-ness", in reaching decision thresholds. In this way, it appears that gaze-cueing more significantly affected visual response, while the perception of celebrity appears to have more greatly influenced choices.

The difficulty in accurately defining and leveraging the perception of "celebrity-ness" challenged my efforts to directly test it in my study. While this study allowed participants to make binary categorizations of celebrity perception, celebrity perceptions are indeed more idiosyncratic and multi-faceted. To increase internal validity, future research should: 1) explore the paradox of the vampire effect, 2) pre-test the perceived "celebrity-ness" of the endorser and what products they might endorse, and 3) draw more descriptive assessments from study participants.

This study identified three other factors: preference, gender, and gaze, that confound the true impact of celebrity gaze-cueing on response. Preference bias has tremendous influence on both visual and choice behaviors. Higher drift rates among celebrity endorsed products suggest that an increase in preference drove more visual attention toward those products. Figure 12 illustrates that individuals were unlikely to change their choices even if the preference differential between two alternatives was minor. As it relates to the various celebrity and gaze-

cueing conditions, a comparison between Figures 14 and 15 illustrates how preference bias can cast uncertainty on the impact of celebrity gaze-cueing on choice.

Figure 10 clarifies that a celebrity endorsement encourages choice for the endorsed product when preference bias is weak; however, when preference is moderate or high, the influence of celebrity endorsements is more muted. This finding mirrors other studies where other visual manipulations aimed at increasing salience ultimately influenced choices, but mostly when individuals lack strong preference for the options (Milosavljevic et al., 2012).

Preference bias not only obfuscates the impact of celebrity gaze-cueing on choice decisions, but also explains why a strong majority of participants selected real products for which they indicated high preference, as illustrated in Figure 16. These results suggest that preference bias cannot be ignored in studying the effect of social status or joint attention on decision making; on the contrary, these results indicate that weak preference among alternatives makes the choice more vulnerable to an intervention. This suggests the need for a future experimental design that would limit the real snack foods to those options for which participants had less preference.

Lastly, and most surprisingly, the participant's and endorser's gender significantly influenced visual and choice responses. Male participants spent more time looking at the face when the endorser was male; consistently, females spent more time dwelling on the face when the endorser was female, as illustrated by Figure 7. Males and females also had different choice behaviors to the various celebrity gaze-cueing conditions. Figure 13 shows that female participants more often than males chose a celebrity endorsed product wherein the endorser was gazing at the product; in contrast, male participants were more responsive to gaze-cueing at the viewer. We observed that endorsements in general, and celebrity endorsements in particular, had

stronger effects on the choices of females than those of males. This finding aligns with biological research on gender and evolutionary predispositions (Sy et al., 2010; Ohlsen and Zoest, 2013). Although dwell times did not significantly differ between the sexes, the participant population's gender distribution (70 percent female) makes it difficult to accurately determine how the participant's and endorser's gender might impact visual and choice responses. Future research should establish a more balanced gender distribution of participants to increase the internal validity of gender effects.

Conclusion

The attention of consumers has never been more fragmented, posing a unique challenge to academics and marketers trying to understand various response behaviors. Basic human tendencies persist that operate on an involuntary or subconscious basis to shape human behaviors, especially when bias is minimal. Such is the case for the effects of social status or joint attention on informing what we look at and what we choose. Using novel approaches in experimental design and statistics, this study sought a rigorous method that could extend our current understanding of why and how human behavior is shaped by those whom we deem socially relevant or popular.

While we expected that visual attention toward a product would drive greater choice of that product, results suggest a disconnect that demands a more multidimensional answer. The way in which humans accumulate and process information is critical to understanding the complexity of how advertising contexts might influence choice decision making and choice responses. The easier it is to process certain information, the greater effect it will have on subsequent decisions. Our study validated this phenomenon by demonstrating that visual

interventions influence binary and real life choices. Pre-existing biases, such as preference and

gaze, often overwhelmed the effectiveness of these interventions. However, when bias was

negligent, social status and joint attention transformed several visual and choice behavioral

responses. Perceptions and endorsements of our own favorite people continuously shape us. The

person who got me hooked on Cheetos is no exception.

References

Adil, Safaa, Sophie Lacoste-Badie, and Olivier Droulers. "Face Presence and Gaze Direction In Print Advertisements." *Journal of Advertising Research* 58, no. 4 (December 19, 2018): 443–55. https://doi.org/10.2501/jar-2018-004.

Amos, Clinton, Gary Holmes, and David Strutton. "Exploring the Relationship between Celebrity Endorser Effects and Advertising Effectiveness." *International Journal of Advertising* 27, no. 2 (2008): 209–34. https://doi.org/10.1080/02650487.2008.11073052.

Bergkvist, Lars, and Kris Qiang Zhou. "Celebrity Endorsements: a Literature Review and Research Agenda." *International Journal of Advertising* 35, no. 4 (June 2016): 642–63. https://doi.org/10.1080/02650487.2015.1137537.

Choi, Sejung Marina, Wei-Na Lee, and Hee-Jung Kim. "LESSONS FROM THE RICH AND FAMOUS: A Cross-Cultural Comparison of Celebrity Endorsement in Advertising." *Journal of Advertising* 34, no. 2 (2005): 85–98. https://doi.org/10.1080/00913367.2005.10639190.

Chung, Kevin Yc, Timothy P. Derdenger, and Kannan Srinivasan. "Economic Value of Celebrity Endorsements: Tiger Woods Impact on Sales of Nike Golf Balls." *Marketing Science* 32, no. 2 (March 2013): 271–93. https://doi.org/10.1287/mksc.1120.0760.

Ding, Haina, Alexander E. Molchanov, and Philip A. Stork. "The Value of Celebrity Endorsements: A Stock Market Perspective." *Marketing Letters* 22, no. 2 (August 2010): 147–63. https://doi.org/10.1007/s11002-010-9117-y.

Engell, Andrew D., and James V. Haxby. "Facial Expression and Gaze-Direction in Human Superior Temporal Sulcus." *Neuropsychologia* 45, no. 14 (2007): 3234–41. https://doi.org/10.1016/j.neuropsychologia.2007.06.022.

Erfgen, Carsten, Sebastian Zenker, and Henrik Sattler. "The Vampire Effect: When Do Celebrity Endorsers Harm Brand Recall?" *International Journal of Research in Marketing* 32, no. 2 (2015): 155–63. https://doi.org/10.1016/j.ijresmar.2014.12.002.

Friesen, Chris Kelland, and Alan Kingstone. "The Eyes Have It! Reflexive Orienting Is Triggered by Nonpredictive Gaze." *Psychonomic Bulletin & Review* 5, no. 3 (1998): 490–95. https://doi.org/10.3758/bf03208827.

Galfano, Giovanni, Mario Dalmaso, Daniele Marzoli, Giulia Pavan, Carol Coricelli, and Luigi Castelli. "Eye Gaze Cannot Be Ignored (but Neither Can Arrows)." *Quarterly Journal of Experimental Psychology* 65, no. 10 (February 2012): 1895-1910. https://doi.org/10.1080/17470218.2012.66376

Heron-Delaney, Michelle, Gizelle Anzures, Jane S. Herbert, Paul C. Quinn, Alan M. Slater, James W. Tanaka, Kang Lee, and Olivier Pascalis. "Perceptual Training Prevents the Emergence of the Other Race Effect during Infancy." *PLoS ONE* 6, no. 5 (2011). https://doi.org/10.1371/journal.pone.0019858.

Hood, Bruce M., J.douglas Willen, and Jon Driver. "Adults Eyes Trigger Shifts of Visual Attention in Human Infants." *Infant Behavior and Development* 21 (1998): 466. https://doi.org/10.1016/s0163-6383(98)91679-4.

Hungr, Clara J., and Amelia R. Hunt. "Rapid Communication: Physical Self-Similarity Enhances the Gaze-Cueing Effect." *Quarterly Journal of Experimental Psychology* 65, no. 7 (2012): 1250–59. https://doi.org/10.1080/17470218.2012.690769.

Hutton, S. B., and S. Nolte. "The Effect of Gaze Cues on Attention to Print Advertisements." *Applied Cognitive Psychology* 25, no. 6 (March 2011): 887–92. https://doi.org/10.1002/acp.1763.

Itier, Roxane J., and Magali Batty. "Neural Bases of Eye and Gaze Processing: The Core of Social Cognition." *Neuroscience & Biobehavioral Reviews* 33, no. 6 (2009): 843–63. https://doi.org/10.1016/j.neubiorev.2009.02.004.

Kahneman, Daniel, and Amos Tversky. "Prospect Theory. An Analysis of Decision Making Under Risk," January 1977. https://doi.org/10.21236/ada045771.

Karczmarek, Paweł, Witold Pedrycz, Adam Kiersztyn, and Przemysław Rutka. "A Study in Facial Features Saliency in Face Recognition: an Analytic Hierarchy Process Approach." *Soft Computing* 21, no. 24 (March 2016): 7503–17. https://doi.org/10.1007/s00500-016-2305-9.

Keysers, Christian, and Valeria Gazzola. "Integrating Simulation and Theory of Mind: from Self to Social Cognition." *Trends in Cognitive Sciences* 11, no. 5 (2007): 194–96. https://doi.org/10.1016/j.tics.2007.02.002.

Krajbich, Ian, Carrie Armel, and Antonio Rangel. "Visual Fixations and the Computation and Comparison of Value in Simple Choice." *Nature Neuroscience* 13, no. 10 (September 12, 2010): 1292–98. https://doi.org/10.1038/nn.2635.

Krajbich, Ian, Dingchao Lu, Colin Camerer, and Antonio Rangel. "The Attentional Drift-Diffusion Model Extends to Simple Purchasing Decisions." *Frontiers in Psychology* 3 (June 13, 2012). https://doi.org/10.3389/fpsyg.2012.00193.

Kuhn, G., and A. Kingstone. "Look Away! Eyes and Arrows Engage Oculomotor Responses Automatically." *Attention, Perception & Psychophysics* 71, no. 2 (January 2009): 314–27. https://doi.org/10.3758/app.71.2.314.

Liuzza, Marco Tullio, and Valentina Cazzato. "Follow My Eyes: The Gaze of Politicians Reflexively Captures the Gaze of Ingroup Voters." *PLoS ONE* 6, no. 9 (2011). https://doi.org/10.1371/journal.pone.0025117.

Milosavljevic Milica, Vidhya Navalpakkam, Christof Koch, and Antonio Rangel. "Relative visual saliency differences induce sizable bias in consumer choice." *Journal of Consumer Psychology* 22, no. 1 (January 2012): 67-74.

Ohlsen, Garian, Wieske Van Zoest, and Mark Van Vugt. "Gender and Facial Dominance in Gaze Cuing: Emotional Context Matters in the Eyes That We Follow." *PLoS ONE* 8, no. 4 (March 2013). https://doi.org/10.1371/journal.pone.0059471.

Parr, Lisa A. "The Evolution of Face Processing in Primates." *Philosophical Transactions of the Royal Society B: Biological Sciences* 366, no. 1571 (December 2011): 1764–77. https://doi.org/10.1098/rstb.2010.0358.

Peirce, Jonathan, and Jeremy R. Gray. "PsychoPy2: Experiments in Behavior Made Easy." *Behavior Research Methods* 51, no. 1 (2019): 195–203. https://doi.org/10.3758/s13428-018-01193-y.

Philiastides, Marios G., and Roger Ratcliff. "Influence of Branding on Preference-Based Decision Making." *Psychological Science* 24, no. 7 (2013): 1208–15. https://doi.org/10.1177/0956797612470701.

Rangel, Antonio, Colin Camerer, and P. Read Montague. "A Framework for Studying the Neurobiology of Value-Based Decision Making." *Nature Reviews Neuroscience* 9, no. 7 (November 2008): 545–56. https://doi.org/10.1038/nrn2357.

Ricciardelli, Paola, Emanuela Bricolo, Salvatore M. Aglioti, and Leonardo Chelazzi. "My Eyes Want to Look Where Your Eyes Are Looking: Exploring the Tendency to Imitate Another Individual??s Gaze." *NeuroReport* 13, no. 17 (2002): 2259–64. https://doi.org/10.1097/00001756-200212030-00018.

Russell, Cristel Antonia, and Dina Rasolofoarison. "Uncovering the Power of Natural Endorsements: a Comparison with Celebrity-Endorsed Advertising and Product Placements." *International Journal of Advertising* 36, no. 5 (July 13, 2017): 761–78. https://doi.org/10.1080/02650487.2017.1348033.

Sajjacholapunt, Pitch, and Linden J. Ball. "The Influence of Banner Advertisements on Attention and Memory: Human Faces with Averted Gaze Can Enhance Advertising Effectiveness." *Frontiers in Psychology* 5 (April 2014). https://doi.org/10.3389/fpsyg.2014.00166.

Schirmer, Annett, Cui Shan Seow, and Trevor B. Penney. "Humans Process Dog and Human Facial Affect in Similar Ways." *PLoS ONE* 8, no. 9 (April 2013). https://doi.org/10.1371/journal.pone.0074591.

Schwartzstein, Joshua. "Selective Attention And Learning." *Journal of the European Economic Association* 12, no. 6 (March 2014): 1423–52. https://doi.org/10.1111/jeea.12104.

Senju, Atsushi, and Mark H. Johnson. "The Eye Contact Effect: Mechanisms and Development." *Trends in Cognitive Sciences* 13, no. 3 (2009): 127–34. https://doi.org/10.1016/j.tics.2008.11.009.

Shepherd, Stephen V., Robert O. Deaner, and Michael L. Platt. "Social Status Gates Social Attention in Monkeys." *Current Biology* 16, no. 4 (2006). https://doi.org/10.1016/j.cub.2006.02.013.

Simion, Claudiu, and Shinsuke Shimojo. "Interrupting the Cascade: Orienting Contributes to Decision Making Even in the Absence of Visual Stimulation." *Perception & Psychophysics* 69, no. 4 (2007): 591–95. https://doi.org/10.3758/bf03193916.

Strick, Madelijn, Rob W. Holland, and Ad Van Knippenberg. "Seductive Eyes: Attractiveness and Direct Gaze Increase Desire for Associated Objects." *Cognition* 106, no. 3 (May 2007): 1487–96. https://doi.org/10.1016/j.cognition.2007.05.008.

Sy, J. L., and B. Giesbrecht. "Whos Looking at You? Gender and Familiarity Modulate Gaze Cueing." *Journal of Vision* 7, no. 9 (2010): 15–15. https://doi.org/10.1167/7.9.15.

Perrett, D., and Smith, J. "Visual Cells in the Temporal Cortex Sensitive to Face View and Gaze Direction." *Proceedings of the Royal Society of London. Series B. Biological Sciences* 223, no. 1232 (1985): 293–317. https://doi.org/10.1098/rspb.1985.0003.

Wiecki, Thomas V., Imri Sofer, and Michael J. Frank. "HDDM: Hierarchical Bayesian Estimation of the Drift-Diffusion Model in Python." *Frontiers in Neuroinformatics* 7 (2013). https://doi.org/10.3389/fninf.2013.00014.

Zipporah, Mwendwa Mildred, and Hellen K. Mberia. "The Effects of Celebrity Endorsement in Advertisements." *International Journal of Academic Research in Economics and Management Sciences* 3, no. 5 (April 2014). https://doi.org/10.6007/ijarems/v3-i5/1250.

Zwilling, Moti, and Gila E. Fruchter. "Matching Product Attributes To Celebrities Who Reinforce the Brand." *Journal of Advertising Research* 53, no. 4 (December 2013): 391–410. https://doi.org/10.2501/jar-53-4-391-410.