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1 Choice and Quantity in Conflict: Misleading Inferences
 2 Dynamics of Self-Control from Observed Behavior
 3 During Choice and Post-Choice Consumption Quantity

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13 **Keywords:** self-control, goal accessibility, food decision making, dietary restraint,
 14 exploratory research.

15 **Abstract**

16 Consumer psychologists often make inferences about Observed choices between options
 17 representing a consumer's relative vice and a relative virtue have commonly been used as a
 18 measure of eating self-control based on their observed choices of vice versus virtue foods. This
 19 in the literature. However, even though self-control operations may manifest across the post-
 20 choice consumption stage, either similarly or in different ways from the choice stage, most prior
 21 research proposes that such inferences based on choice alone may be misleading because they
 22 ignore actual consumption that only occurs post-choice. Using an endogenous
 23 treatment regression model that simultaneously models both choice and quantity, the authors find
 24 that of the chosen option. While the behavior of choosing a virtue instead of a vice does
 25 manifest self-control implications assessed using only choice may be systematically different
 26 from those that also account for quantity consumed, we examine how this plays out in post-
 27 choice consumption. Specifically, we find that when processing resources are limited, after
 28 choosing a virtue (from which researchers would normally make an inference of high self-
 29 control), chronically having chosen a virtue food, unrestrained eaters ironically
 30 consume greater quantities and therefore more calories (Study 1). This happens than
 31 restrained eaters (Study 1). This reflects more persistent self-control in the post-choice
 32 consumption stage among restrained eaters than unrestrained eaters, and occurs because
 33 choosing a virtue lowers accessibility of the self-control goal for among unrestrained eaters
 34 relative to restrained eaters (Study 2), thereby increasing intake of the virtuous food. In
 35 contrast, subsequent to having chosen a vice, unrestrained eaters and restrained eaters did not
 36 show any such difference in intake (Study 1) or goal accessibility (Study 2). Together, these
 37 results reveal a systematic and predictable disparity between choice and quantity decisions in the
 38 that persistence of self-control in the post-choice consumption stage depends on individuals'
 39 dietary restraint and their initial exercise of self-control in the choice decision. The mere act of

40 choosing a virtue satisfies unrestrained eaters' self-control goal and leads to increased food
41 intake, whereas the same act keeps the same goal activated among restrained eaters who reduce
42 intake of the chosen virtue. Put differently, persistent self-control across choice and quantity
43 decisions is observed only when those with a dietary goal show successful self-control enactment
44 in the choice stage. We therefore highlight that the operation of self-control. We therefore
45 caution that the popular practice of inferring self control from choice alone may well be
46 insufficient in understanding the operation of self control. ~~is~~can be dynamic within a
47 consumption episode, and thus, choice and post-choice quantity decisions are critically both
48 informative of self-control.

49 Word count: ~~110,992~~274 words

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51

52 1. Introduction

53 A consumer psychologist observes someone make a choice between a slice of chocolate cake and
 54 a bowl of fruit salad, a classic measure of self-control (Shiv and Fedorikhin, 1999). What does
 55 the choice reveal about the person's self-control? Since chocolate cake (i.e., a "relative vice"
 56 (Wertenbroch, 1998)) is perceived as being relatively tastier but less healthy relative to fruit
 57 salad ("a relative virtue"), the choice of chocolate cake is usually interpreted as indicative of a
 58 lack of self-control. Correspondingly, a choice of fruit salad is attributed to the successful
 59 operation of self-control. Such inferences based on observing similar choices are a cornerstone of
 60 the literature on self-control—a recent review of the relevant literature from 1998 to 2018
 61 identified that over 120 published articles relied on such vice versus virtue choices to
 62 operationalize self-control (Vosgerau et al., 2020).¹

63 ~~Although this heuristic mapping of observed choice on inferred self-control is intuitively~~
 64 ~~appealing, it has some critical limitations. The most apparent is that someone may simply choose~~
 65 ~~one of the two options without any conflict or invocation of self-control. Choices may be made~~
 66 ~~for reasons completely irrelevant to self-control, such as preferences or constraints. In these~~
 67 ~~cases, the choice of the virtue is not indicative of self-control since there is no~~
 68 ~~Indeed, the choice of the virtue is indicative of self-control enactment as long as the choice task elicits~~
 69 ~~conflict between desire and willpower – a critical and necessary component of self-control operations~~
 70 ~~(Hoch and Loewenstein, 1991, Berman and Small, 2018). For example, they may simply prefer~~
 71 ~~the taste of the fruit to that of chocolate, or they may be intolerant of the gluten in the cake.~~
 72 ~~However, such choice behaviors that are not influenced by once consumers start eating the~~
 73 ~~chosen virtue, will the self-control should be distributed randomly among participants, and thus~~
 74 ~~may not systematically bias the results overall. A second, subtler but unresolved, concern is that~~
 75 ~~choice by itself may not be indicative of quantity expressed in their virtue choice be sustained?~~
 76 ~~For example, will it lead to lower consumption. The of the chosen virtue? What if a person who~~
 77 ~~chooses the fruit salad and is while successfully giving up chocolate cake and therefore ascribed~~
 78 ~~as having high shows successful enactment of self-control may but then consume consumes an~~
 79 ~~excessively large quantity— of the chosen fruit salad? This would be evidence for low of a lapse~~
 80 ~~in self-control that is completely would be missed by researchers who only observed her choice.~~
 81 ~~Also, if consumers fail to exercise self-control at the choice stage by choosing a vice, will they~~
 82 ~~just devour in the following consumption stage? These questions are This question is relevant to~~
 83 ~~the well-being of consumers because food choice decision and quantity consumption decision~~
 84 ~~jointly determine calorie and nutrient intake. The post-choice consumption stage is usually~~
 85 ~~longer than the choice stage and thus, allows for longer time to decide when to stop eating, as~~
 86 ~~compared to the prior decision of what to eat in the choice stage. However, researchers have~~
 87 ~~rarely considered the possibility that revealed self-control may change across the choice and~~
 88 ~~post-choice consumption stages. In this research, we explicitly test how self-control relates~~
 89 ~~to may change over choice versus and post-choice quantity in situations such as this, decisions~~
 90 ~~within a single consumption episode and find that post-choice quantity consumption is in fact~~

¹ While the chocolate cake and fruit salad pairing has remained popular (Biswas et al., 2014, Usta and Häubl, 2011), many other sets of stimuli have been used, such that the options selected as vices are perceived to be tastier but less healthy than the ones selected as virtues (e.g., a chocolate bar and a granola bar (Patrick and Hagtvedt, 2012); M&M's and grapes (Fedorikhin and Patrick, 2010); French fries and salad (Wilcox et al., 2011)).

91 ~~systematically discrepant from choice evidence for changing self-control within a consumption~~
 92 ~~episode, highlighting the dynamic operation of self-control.~~

93 In what follows, we review literature that has adopted food choice between a vice and a virtue as
 94 a measure of self-control, ~~discuss potential limitations of this and food intake as a measure, and~~
 95 ~~introduce the relationship between~~ of self-control and consumption quantity. ~~We then.~~ Next, we
 96 introduce a theoretical framework which consists of two stages—a choice stage followed by a
 97 post-choice consumption stage; ~~and discuss how we investigate the potential dynamic of self-~~
 98 ~~control across choice and post-choice consumption stages by examining them together. We then~~
 99 ~~discuss how individual differences can play a role in this two-stage consumption decision~~
 100 ~~framework.~~ Using an endogenous treatment regression model (Krishnamurthi and Raj, 1988) that
 101 allows us to analyze quantity contingent on choice, in Study 1, we demonstrate that quantity
 102 consumption of a chosen food can ~~lead to different inferences~~ reflect divergent levels of self-
 103 control ~~from choice depending on individuals' dietary restraint.~~ When cognitive resources were
 104 constrained, among those who chose a virtue, decreasing levels of trait dietary restraint were
 105 ironically associated with greater consumption quantities and therefore more calories. ~~This~~
 106 ~~suggests that self-control is no longer sustained among unrestrained eaters after a virtue choice as~~
 107 ~~much as their restrained counterparts.~~ In Study 2, we investigate the underlying process for
 108 unrestrained eaters' ~~lack of losing~~ self-control over their consumption of their chosen virtue, by
 109 examining post-choice accessibility of the self-control goal. We conclude with a discussion of
 110 theoretical contributions, limitations, and future research.

111 2. Conceptual Framework

112 2.1. Self-control and the choice of virtue over vice

113 Self-control is the “struggle between the two psychological forces of desire and willpower”
 114 (Hoch and Loewenstein, 1991). Willpower induces people to act in line with their long-term
 115 goals, whereas desire attracts them to temptations that deviate from these goals. Hence self-
 116 control is often viewed as the conflict between “sooner-smaller” rewards with “later-larger”
 117 outcomes (Ainslie, 1975). Wertenbroch (1998) conceptualized this conflict at the product level
 118 with the insight that some products deliver relatively greater value in the short than in the long
 119 term, whereas others deliver greater value in the long term. In his terminology, the former class
 120 of products are called “relative vices” while the latter class are called “relative virtues”. ~~This~~
 121 ~~distinction between vices and virtues is simple and intuitively appealing, and aligns with~~
 122 ~~consumers' categorization of foods into good or bad (Okada, 2005, Thomas et al., 2011).~~

123 As aforementioned, Shiv and Fedorikhin (1999) operationalized the choice between chocolate
 124 cake and fruit salad as a measure of self-control. According to their affective-cognitive model of
 125 self-control operation, affective responses favor a vice but cognitive responses need to override
 126 affective responses to favor a virtue. Shiv and Fedorikhin demonstrated that when affective
 127 processing was facilitated relative to cognitive responses, impulsive (but not non-impulsive)
 128 people were more likely to choose chocolate cake than fruit salad. ~~This suggests that trait self-~~
 129 ~~control can manifest in one's behavior when relative dominance of affect is induced. In this case,~~
 130 ~~there was a reasonable correspondence between the observed choice and the “real” underlying~~
 131 ~~trait, allowing inferences of self-control from observed choice behavior. This is how researchers~~
 132 ~~observe choice to make an inference about the decision maker's self-control enactment: the~~

133 [choice of the vice represents a failure whereas the choice of the virtue indicates a success in](#)
 134 [enactment of self-control. A pilot survey among lay consumers corroborates researchers' focus](#)
 135 [on self-control in the choice stage.²](#)

136 [Following Shiv and Fedorikhin's \(1999\) seminal paper, the choice between a vice and a virtue](#)
 137 [has become a popular measure of self-control in the burgeoning literature on self-control](#)
 138 [\(Vosgerau et al., 2020\). While the chocolate cake and fruit salad pairing has remained popular](#)
 139 [\(Biswas et al., 2014, Usta and Häubl, 2011\), many other sets of stimuli have been used, such that](#)
 140 [the options selected as vices are perceived to be tastier but less healthy than the ones selected as](#)
 141 [virtues \(e.g., a chocolate bar and a granola bar \(Patrick and Hagtvedt, 2012\); M&M's and grapes](#)
 142 [\(Fedorikhin and Patrick, 2010\); French fries and salad \(Wilcox et al., 2011\)\). In each of these](#)
 143 [studies, researchers observe choice to make an inference about the decision maker's self-control:](#)
 144 [the choice of the vice represents low self-control whereas the choice of the virtue indicates high](#)
 145 [self-control. This mapping between choice and self-control is simple and intuitively appealing,](#)
 146 [and aligns with consumers' categorization of foods into good or bad \(Okada, 2005, Thomas et](#)
 147 [al., 2011\).](#)

148 ~~However, there is a critical conceptual issue with such analyses based on such a focus only~~
 149 ~~choice. That is, such analyses neglect any possible effects on actual consumption, thereby~~
 150 ~~providing on choice behavior may provide a possibly incomplete picture of self-control~~
 151 ~~operations. Moreover, till date, research has not systematically considered the possibility that~~
 152 ~~such a picture may not only be incomplete, but since this might also be misleading in terms of~~
 153 ~~what it reveals about the chooser's self-control change from the choice behavior to the post-~~
 154 ~~choice consumption stage. In order to develop this more complete picture, we first discuss how~~
 155 ~~extant research that has investigated corresponded self-control using to food consumption~~
 156 ~~quantity, as opposed to choice.~~

157 2.2. Consumption quantity and self-control

158 While much research has investigated self-control as reflected in choice, there has also been an
 159 effort to investigate the relationship between self-control and quantity. However, prior research
 160 on food intake in relation to self-control has examined consumption while largely
 161 neglecting skipping the choice stage (May and Irmak, 2014, Mehta et al., 2014, Tice et al., 2001),
 162 limited the available choices to being either only vices or only virtues (Finkelstein and Fishbach,
 163 2010, Redden and Haws, 2013), or investigated yes or no decisions on vices (e.g., whether to eat

² We conducted a survey to see if people primarily rely on food choice rather than quantity decision for typical food consumption decisions: meal and snack. We recruited American participants ($N = 200$, 43.5% female; $M_{age} = 43.03$) from Amazon Mechanical Turk and asked which one they focus more on between "what I should eat" and "how much I should eat" for a meal and for a snack separately (1 = I focus mainly on "what I should eat"; 7 = I focus mainly on "how much I should eat"). A one-sample t-test revealed that for the meal consumption, people tend to focus more on what they should eat ($M = 3.32$; $t(199) = -5.12$, $p < .001$); but for the snack consumption, people equally focus on what they should eat and how much they should eat ($M = 3.81$; $t(199) = -1.41$, $p = .159$). Given that meals are more frequent food decisions than snacks and constitute a majority of daily calorific intake (Kant, 2018), this suggests that consumers primarily focus on food choice rather than quantity.

164 cookies or not (Ramanathan and Menon, 2006, Coelho Do Vale et al., 2008, Patrick et al.,
 165 2009)). ~~Similar to our above argument, omitting the choice stage runs the risk of biasing the~~
 166 ~~quantity decision. However, consumers often make a food choice first and then decide how much~~
 167 ~~they consume the chosen food. Omitting the choice stage and observing consumption intake only~~
 168 ~~may well have a different impact on self-control compared to observing consumption intake~~
 169 ~~following a free choice.~~ For example, being forced to eat a specific food might lead to a feeling
 170 of lack of responsibility (Chen and Sengupta, 2014) or reactance (Finkelstein and Fishbach,
 171 2010), ~~which can potentially influence self-control exertion in the consumption stage.~~ In the
 172 current research, ~~as our focus is to avoid such unwanted influences~~ ~~we assess the dynamics of food~~
 173 ~~type assignment, we investigate self-control across the choice decision and the post-choice~~
 174 ~~quantity intake in a single consumption episode in which, we avoid forcing such a food type~~
 175 ~~assignment but instead allow~~ choice and quantity decisions ~~are to be~~ interdependent.

176 Examining the ~~role~~ ~~manifestation~~ of self-control in ~~terms of post-choice~~ quantity is critical since
 177 over-consumption of calories is the single most significant contributor to obesity (Livingston,
 178 2012). Inferences of self-control from consumption quantity decisions usually follow a linear
 179 relationship, with lower quantities being associated with higher self-control (Belei et al., 2012,
 180 Aydinoglu and Krishna, 2011). ~~In~~ ~~Accordingly, in~~ the current research, we treat increasing
 181 quantity intake is associated with lower self-control regardless of whether the food is regarded as
 182 a virtue or a vice in the choice context. That is because the over-consumption problem is not an
 183 exclusive matter of vice foods. Eating only virtuous foods can result in excessive calorie intake
 184 and thus consumers need to control the intake of virtues as well as vices. ~~While there is a~~
 185 ~~consensus that over-consumption of vices is a self-control problem, there is a question about the~~
 186 ~~over-consumption of virtues. On one hand, virtues are, by nomenclature, “good”, and hence the~~
 187 ~~more they are consumed, the better. Following such a logic, consequently, the greater the~~
 188 ~~consumption of virtues, the higher the self-control is assumed (Redden and Haws, 2013, Siddiqui~~
 189 ~~et al., 2017). However, this philosophy focuses on the choice part of the equation. The other~~
 190 ~~position focuses more on quantity, specifically, the over-consumption aspect. This position~~
 191 ~~argues that not only are vices best consumed in moderation, but the same should apply to virtues~~
 192 ~~even though the specific reasons may differ. We follow the latter, for the following reasons.~~

193 ~~Although consumers tend to easily justify eating or purchasing large quantities of virtues (Mishra~~
 194 ~~and Mishra, 2011, Provencher et al., 2009, Wertenbroch, 1998), eating larger quantities~~
 195 ~~necessarily increases calorie intake. Indeed, quantity (not choice), accounts for two thirds of the~~
 196 ~~variance in energy intake from food consumption (Schusdziarra et al., 2010). Increasing calorific~~
 197 ~~intake can be pleasurable because of increased dopamine release (De Araujo et al., 2008), and~~

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198 this pleasure can induce over-consumption—indicating that self-control may be required, to
 199 some extent, to limit consumption of all palatable foods, not just stereotypical vices.³

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200 Importantly, there are no absolute virtues or vices by definition – they are defined relative to
 201 each other (Vosgerau et al., 2020, Wertenbroch, 1998), and malleable across contexts (Irmak et
 202 al., 2011, Levin and Gaeth, 1988). Many food items used as virtues in experiments (e.g., fruit
 203 salad, granola bars) are well above acceptable levels of taste, and the caloric density of these
 204 foods is not negligible. Indeed, contrary to stereotypical beliefs, virtues can contain more calories
 205 than vices (Howlett et al., 2009, Oakes and Slotterback, 2005), and even stereotypically virtuous
 206 foods can have adverse health outcomes if consumed in excess (Ulrich and Potter, 2006). This is
 207 consistent with a pilot survey we ran, which showed that lay consumers do understand that
 208 virtuous foods should not be overconsumed.⁴

209 We conducted a pilot survey to examine whether lay consumers also believe that over-
 210 consumption of virtues can harm their long-term goal of health, and the results demonstrate that
 211 they do. From the same student population pool as in the main studies, 193 undergraduate
 212 students (52.3% female; $M_{age} = 20.17$) indicated the extent to which they agreed with each of two
 213 statements (1 = I strongly disagree; 7 = I strongly agree): “If some food is good for health, it is
 214 okay to eat the food without limiting the quantity” and “Eating a large quantity of healthy foods

³ While there is a consensus that over-consumption of vices is a self-control problem, there is a
question about the over-consumption of virtues. On one hand, virtues are, by nomenclature,
“good”, and hence the more they are consumed, the better. Following such a logic, consequently,
the greater the consumption of virtues, the higher the self-control is assumed (Redden and Haws,
2013, Siddiqui et al., 2017). However, this philosophy focuses on the choice part of the equation.
The other position focuses more on quantity, specifically, the over-consumption aspect. This
position argues that not only are vices best consumed in moderation, but the same should apply
to virtues even though the specific reasons may differ. We follow the latter, for the following
reasons. Although consumers tend to easily justify eating or purchasing large quantities of
virtues (Mishra and Mishra, 2011, Provencher et al., 2009, Wertenbroch, 1998), eating larger
quantities necessarily increases calorie intake. Indeed, quantity (not choice), accounts for two-
thirds of the variance in energy intake from food consumption (Schusdziarra et al., 2010).
Increasing caloric intake can be pleasurable because of increased dopamine release (De Araujo
et al., 2008), and this pleasure can induce over-consumption – indicating that self-control may be
required, to some extent, to limit consumption of all palatable foods, not just stereotypical vices.

⁴ We conducted a pilot survey to examine whether lay consumers also believe that over-
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students (52.3% female; $M_{age} = 20.17$) indicated the extent to which they agreed with each of two
statements (1 = I strongly disagree; 7 = I strongly agree): “If some food is good for health, it is
okay to eat the food without limiting the quantity” and “Eating a large quantity of healthy foods
is always good for health.” The mean belief score (2-item, $\alpha = .76$, $M = 3.38$, $SD = 1.37$) was
significantly lower than the mid-point of the scale (target value = 4, one sample t test, $t(192) = -$
6.32, $p < .001$), indicating that participants generally believed that eating virtues without
limiting quantity is not necessarily good for health.

of energy and nutrients. One can have too much of a good thing. Consequently, there is a need for self-control to regulate consumption quantity, for vices as well as virtues. However, a limitation in the extant literature is that most studies consider choice and quantity consumption decisions separately. In this research, we aim to extend our investigation to post-choice consumption behavior to see how self-control operates dynamically across choice and quantity decisions.

2.3. A two-stage decision framework for self-control operation in food consumption

Food consumption can be analyzed as a two-stage decision process wherein a consumer first chooses what to eat (choice stage), and then decides how much of the chosen option to consume (quantity stage) (Drewnowski, 1997, Wansink and Chandon, 2014). In some decision contexts, food choice and quantity decisions can be made simultaneously (e.g., choosing the flavors and the number of scoops at an ice cream parlor (Oh et al., 2022), and mixtures of vices and virtues may be chosen (e.g., choosing from vice-virtue bundles with different relative proportions (Liu et al., 2015)), which is beyond the scope of our investigation. As discussed, self-control processes may be relevant to both stages—they may influence be manifested in both choice and quantity-decisions. The untested premise is whether self-control manifested in choice may persist to the post-choice consumption stage. If observed choices are sufficient to accurately infer the the chooser's self-control persists in the post-choice consumption stage, post-choice quantity consumption should follow parallel patterns: those who choose a vice should eat a greater quantity of their chosen item because greater quantities consumed are representative of weaker self-control, whereas, in contrast, those who choose a virtue should eat less. This is the most basic prediction, and it is the one most implicit in the literature. However, if we allow for the possibility that choice may not perfectly represent self-control operates dynamically in the two-stage decision framework, a number of different possibilities emerge in the post-choice consumption stage. For example, it is possible that consumers who chose a virtue might end up eating large quantities because they deplete their self-regulatory resources (Muraven and Baumeister, 2000); or they feel it is acceptable to do so (Scott et al., 2008). Correspondingly, the choice of a vice does not necessarily imply that a large quantity will be eaten. It. By contrast, it is also possible that consumers who chose a vice might decide to eat a small quantity of the chosen vice —, which can be an instantiation example of planned indulgence or “self-control for the righteous” (Kivetz and Simonson, 2002)). In other words, the effects at these two stages need not necessarily correspond (with low self-control choices leading to lowered self-control in intake quantity), but may be interdependent. Moreover, once a consumer starts eating a chosen food, many factors other than self-control (e.g., hunger, in Nederkoorn et al., 2009) can affect the quantity eaten (Mela 2006; Wansink and Chandon 2014; Sclafani 2001; Wren et al. 2001; Yeomans 1998), which suggests that one's self-control exertion can be changed at the consumption stage. Correspondingly, the choice of a vice does not automatically lead to a large quantity eaten; and vice versa. In other words, it is possible that self-control does not always persist over choice and quantity stages. Therefore, for a comprehensive understanding of the entire self-control process within a consumption episode, it is necessary to investigate choice and quantity consumed together.

Surprisingly, with one exception (Fedorikhin and Patrick, 2010), consumer psychologists investigating self-control operations have largely not measured choice and quantity together in a

259 ~~For the Choice (M&M's) or for the virtue choice (grapes) condition, participants~~
 260 neutral mood condition, participants were more likely to choose grapes than M&M's, and
 261 consumed smaller quantities of M&M's but not grapes once chosen. It is apparent from these
 262 findings that self-control manifested in the choice stage can be manifested differently in the
 263 consumption of the vice lead to convergent implications for self-control (high self-control from
 264 low choice probability for M&M's, as well as high self-control from smaller consumption
 265 quantity), but the same is not true for the virtue stage. Participants were more likely to choose the
 266 virtue (high self-control inference from exerted in the choice stage) but once they chose the
 267 virtue, they also did not eat less (not necessarily high no longer high self-control in the
 268 consumption stage), which is indicative of dynamic self-control operations across the choice and
 269 post-choice consumption stages. In particular, self-control, unless one assumes that expressed in
 270 the virtue choice did not necessarily continue to the grapes were not tasty and they forced
 271 themselves to keep eating). Particularly, post-choice consumption stage, in the higher choice
 272 likelihood for the virtue did not necessarily lead to form of lower intake quantity.

273 While Fedorikhin and Patrick's (2010) findings suggest a potential disparity between choice and
 274 quantity consumption, no systematic research has been conducted to examine the relationship
 275 between choice and quantity consumption. How might these disparities play out? Numerous
 276 theories can be applied in predicting the relationship between choice and quantity. For brevity,
 277 instead of delineating all the possible theoretical predictions, we examine the relationship
 278 empirically and then test a relevant theory. This abductive approach
 279 **2.4. Dynamics of self-control over choice and quantity decisions**

280 While Fedorikhin and Patrick's (2010) findings suggest a potential dynamic operation of self-
 281 control across choice and quantity consumption decisions, no systematic research has examined
 282 how self-control plays out across choice and quantity decisions. Dynamics are inherent in some
 283 conceptualizations of self-control. Within an individual, two players conflict: a planner who is
 284 far-sighted and thus endorses long-term preferences and a doer who is short-sighted and thus
 285 endorses short-term preference (Bénaoui and Pycia, 2002; Thaler and Shefrin, 1981). Even
 286 when consumers intend to regulate their food intake at the time of making a choice, their will
 287 might not necessarily persist till the successful enactment of self-control at the time of post-
 288 choice consumption due to the doer's different preferences from the planner's. Indeed, a meta-
 289 analysis demonstrates that individuals' trait self-control is related to their imagined self-control
 290 behavior to a greater degree than to actual self-control behavior (De Ridder et al., 2012). This
 291 suggests that the enacted self-control via choosing a virtue might not be always evinced in
 292 moderated consumption behavior once one has started to consume the chosen virtue.

293 In exploring whether self-control persists across choice and post-choice consumption decisions
 294 within individuals, we utilize individual differences in self-control as a basis to distinguish those
 295 who are likely to maintain their self-control over decisions (e.g., making a virtue choice in the
 296 choice stage and then keeping low food intake in the consumption stage) from those who are
 297 likely to lose self-control over decisions (e.g., making a virtue choice in the choice stage but
 298 showing high food intake in the consumption stage). Due to the lack of prior investigation that
 299 observes post-choice consumption behavior, we adopt an abductive approach that emphasizes
 300 theory development based on observation of actual behaviors (Baumeister et al., 2007) and
 301 followed by mechanism testing (Janiszewski and Van Osselaer, 2022). Hence, for an exploratory
 302 investigation, we tested three individual difference measures pertinent to self-control, that can

potentially capture the dynamics of self-control over choice and quantity decisions. First, as a measure specific to the food consumption domain, we assessed dietary restraint (Herman and Polivy, 1980). Individuals with high dietary restraint tend to regulate intake of vice food items (Hofmann et al., 2007) and are likely to keep being successful in intake regulation across occasions (van Koningsbruggen et al., 2013). This suggests that those with high dietary restraint, restrained eaters, may be likely to exhibit persistent self-control over choice and quantity decisions, whereas those with low dietary restraint, unrestrained eaters, may be likely to exhibit lost self-control in their post-choice quantity decision stage once they exercise self-control in the choice decision stage. In case of a self-control lapse by choosing a vice in the choice stage, however, it is also an empirical question whether individuals may show the ongoing self-control lapse in the consumption stage. Analogously the same patterns can be predicted with other individual difference measures relevant to self-control, which are more general and less domain-specific, such as trait self-control (Tangney et al., 2004) and consumer impulsivity (Puri, 1996). Those with high self-control or those with low impulsivity may exhibit persistent self-control over choice and quantity decisions (e.g., low food intake after a virtue choice), but those with low self-control or those with high impulsivity may exhibit transient self-control over these decisions (e.g., high food intake after a virtue choice).

2.45. Overview of studies

We conducted two studies to test for systematic disparities between observed ~~explore how self-control operations manifest over~~ choice and quantity ~~in implications for self-control decisions~~. Our empirical strategy for Study 1 referred to Shiv and Fedorikhin's (1999) seminal research, conceptually following their design and procedures closely, and then extending these to include consumption quantity as a dependent variable. Specifically, Study 1 tested how ~~individual differences in dietary self-control influenced (a) (b) post-choice between a virtue and a vice, and (b) quantity consumption of the chosen option was influenced by choice and individual differences~~. Study 1 provided initial evidence that ~~actual self-control changes across the choice stage and the post-choice consumption may lead to different inferences than choice stage~~; after having chosen a virtue, under cognitive load, unrestrained eaters consumed greater quantities and therefore more calories, ~~which reflects their lost self-control after exercising it in the choice stage~~. To investigate the underlying mechanism ~~of the effects observed in Study 1~~, in Study 2, we examined how food choice and dietary restraint interactively influenced the ~~post-choice~~ accessibility of self-control. We found that after having chosen a virtue, unrestrained eaters showed lower accessibility of a self-control goal, supporting the account based on goal accessibility. These studies ~~together~~ reveal that ~~relying only on observed choices of vice versus virtue may be insufficient and inaccurate as a measure of self-control for the dynamics of self-control~~ self-control operation is dynamic across choice and post-choice intake decisions ~~and whether self-control is sustained or lost across depends on individual's dietary restraint~~.

3. Study

3.1. Study 1: Divergent inferences of self-control from choice versus quantity

The purpose of Study 1 was to examine how ~~(a) a post-choice between a virtue and a vice, and (b) quantity consumed consumption~~ of a chosen food, ~~map onto a consumer's self control, could be determined by choice behavior and individual differences~~. Specifically, we tested whether

345 actual consumption would show ~~different consequences~~ changes in manifestations of self-control from food choice, and
 346 whether this varied by individual difference measures including dietary restraint (Herman and
 347 Polivy, 1980) as a measure of domain-specific self-control, general trait self-control (Tangney et
 348 al., 2004) and consumer impulsivity (Puri, 1996). We followed the design of Shiv and
 349 Fedorikhin's (1999) Study 2, aiming to extend their work by measuring post-choice
 350 consumption.

351 According to Shiv and Fedorikhin (1999), individual differences in self-control are manifested in
 352 choice behavior under the following conditions: (1) when cognitive resources are limited and (2)
 353 affective responses are facilitated (Metcalfe and Mischel, 1999). The first condition was
 354 operationalized by imposing high (vs. low) cognitive load, and the second condition by
 355 presenting real (vs. symbolic) food options. These conditions were introduced to weaken the
 356 executive control but to intensify the effect from affective responses favoring a vice, particularly
 357 among those with low trait self-control. Hence, ~~observed the changing nature of self-control over~~
 358 ~~choice of a vice versus a virtue and quantity decisions~~ should better ~~map onto self-control~~ be
 359 observed if these conditions are satisfied. ~~Extending the study from choice to consumption~~
 360 ~~necessarily implies using real foods at the consumption stage, which should evoke affective~~
 361 ~~responses, thereby satisfying the second criterion.~~

362 Consistent with Shiv and Fedorikhin (1999), we predicted that imposing high (vs. low) cognitive
 363 load should increase choice likelihood for the vice among those with low self-control (e.g.,
 364 unrestrained eaters. ~~Furthermore~~). More importantly, we aimed to examine how trait self-control
 365 motivation influences enactment may change in the post-choice quantity decision. ~~We,~~
 366 ~~particularly among those low in trait self-control. Specifically, we expected the post-choice~~
 367 ~~consumption quantity to be either convergent with a choice decision, or divergent. If among~~ those
 368 who chose a virtue, those with high self-control will consume smaller quantities ~~than those who~~
 369 ~~chose a vice, choice and quantity decisions have convergent implications for self-control.~~
 370 ~~Otherwise, compared to their counterparts with low self-control, indicating better sustained self-~~
 371 ~~control in the consumption stage. In other words, self-control should be differently evident over~~
 372 ~~the result will show~~ choice and post-choice quantity consumption provide divergent implications
 373 ~~of decisions, depending on individual differences in~~ self-control, thereby revealing limitations of
 374 ~~the choice measured~~ dynamics of self-control within a single consumption episode.

375 3.1.1. Method

376 3.1.1.1. Participants and design

377 Undergraduate students at a major Asian university (N = 671, 59.5% female; $M_{age} = 20.21$)
 378 participated and were randomly assigned across conditions of a 2 (cognitive load: low vs. high) x
 379 2 (food type: vice vs. virtue) x (~~dietary restraint~~ individual differences) design, with cognitive
 380 load manipulated between-subjects, and food type and individual difference scales (dietary
 381 restraint, self-control, and consumer impulsivity) measured. In all studies, all participants
 382 provided their informed consent in a written form before the participation. Before collecting data
 383 for all studies, the Human Participants Research Panel at Hong Kong University of Science and
 384 Technology reviewed and approved the proposed safety measures for the proposal {BM042}.
 385 Participants chose between virtue and vice options as described below. Conditional on choice,
 386 we assessed the amount that each participant consumed. ~~To address the issue of self-selection,~~

~~Following Hagen et al. (2017), we chose almonds and M&M's as the virtue and vice options in our stimuli. The key consideration was that these are both relatively easy to consume and weigh in discrete units (compared to Shiv and Fedorikhin's cake and fruit salad, which are relatively more heterogeneous in serving sizes and messier to consume and therefore weigh). We conducted one pretest and one posttest to ensure that our participants did indeed perceive these options to be a vice and a virtue as per their definitions. First, in the pretest, 36 participants (72.2% female; $M_{age} = 20.64$) were recruited from the same population pool as the main experiments. Participants saw pictures of the unsalted roasted almonds (private label) and M&M's, which were contained in transparent plastic cups respectively, and evaluated the healthiness and tastiness of both items on 7-point scales. As expected, paired t-test revealed that almonds ($M = 5.22$) were perceived as healthier than M&M's ($M = 2.56$), $t(35) = 8.50$, $p < .001$, but M&M's ($M = 6.14$) were tastier than almonds ($M = 4.31$), $t(35) = -6.82$, $p < .001$.~~

3.1.1.2. Pretest and posttest

Following Hagen et al. (2017), we chose almonds and M&M's as the virtue and vice options in our stimuli. The key consideration was that these are both relatively easy to consume and weigh in discrete units (compared to Shiv and Fedorikhin's cake and fruit salad, which are relatively more heterogeneous in serving sizes and messier to consume and therefore weigh). We conducted one pretest and one posttest to ensure that our participants did indeed perceive these options to be a vice and a virtue as per their definitions. First, in the pretest, 36 participants (72.2% female; $M_{age} = 20.64$) were recruited from the same population pool as the main experiments. Participants saw pictures of the unsalted roasted almonds (private label) and M&M's, which were contained in transparent plastic cups respectively, and evaluated the healthiness and tastiness of both items on 7-point scales. As expected, paired t-test revealed that almonds ($M = 5.22$) were perceived as healthier than M&M's ($M = 2.56$), $t(35) = 8.50$, $p < .001$, but M&M's ($M = 6.14$) were tastier than almonds ($M = 4.31$), $t(35) = -6.82$, $p < .001$.

Second, the posttest examined whether people perceived M&M's contain more calories than almonds, which is consistent with expectations for vice versus virtue foods (Chandon, 2007, Oakes and Slotterback, 2005). In the second pretest, 109 undergraduate students (58.7% female) estimated the calories of M&M's and almonds based on the same pictures as pretest 1. Participants believed the presented quantity of M&M's ($M = 437.78$ calories), contained higher calories than the almonds ($M = 294.28$ calories), $t(108) = -6.65$, $p < .001$. In reality, according to the nutrition labels on the respective packages, roasted almonds (220 calories) contain more calories than M&M's (196 calories), given the same weight (40 grams). The gap between estimated calories of two options did not depend on dietary restraint, $B = 1.37$, $SE = 3.77$, $t(107) = .36$, $p = .717$. Thus, we proceeded with M&M's and almonds as our stimuli.

3.1.1.3. Procedure

Participants came to the lab in groups of one to six, and were met by a research assistant. Each participant was seated in a separate cubicle and worked on an individual PC. Participants read the instructions and responded to a questionnaire programmed on a Qualtrics survey webpage. The experiment was disguised as research on the influence of numeric processing on food tasting. All participants first indicated how hungry they felt at the moment (on a 7-point scale). And then, we manipulated cognitive load by asking participants to remember either an 8-digit number (high cognitive load condition), or a 2-digit number (low cognitive load condition). After this manipulation, we presented all participants with two actual food options (see Supplementary Figure 1 in Supplementary Material-~~file~~), and asked them to choose one to taste. Whichever choice they made, they received 40 grams of their chosen option in a non-transparent plastic cup. These portions had been pre-weighed beforehand in a separate room using an electronic scale. After all participants received their choice of food, they were allowed four minutes to taste their chosen option. We then relieved the cognitive load and asked participants to evaluate the taste of their chosen food (4 items, $\alpha = .94$) with filler questions, ~~followed by which were unrelated to this study. Then, we administered a series of scales for individual differences in self-control including~~ Herman and Polivy's (1980) dietary restraint scale (10-item, $\alpha = .77$) as a domain-specific measure of self-control ~~as well as additional individual difference measures~~, Puri's

429 (1996) consumer impulsiveness scale (impulsiveness: 11-item, $\alpha = .58$,⁵ with prudence subscale,
 430 $\alpha = .84$, hedonic subscale, $\alpha = .48$; one item ‘eating spending’ modified to ‘enjoy eating’ and one
 431 item ‘extravagant’ dropped for its low relevance to eating domain),⁶ and Tangney et al.’s (2004)
 432 brief self-control scale (13-item, $\alpha = .82$), and).⁶⁷ Finally, demographic questions, including age
 433 and gender, were asked. Participants were then debriefed and thanked. After they had all left the
 434 lab, a research assistant weighed the amounts left in each participant’s cup. Calorie intake was
 435 then estimated using the food choice and quantity eaten. Supplementary Table 1 in the
 436 Supplementary Material file contains descriptive statistics and correlations of measured
 437 variables. In this study and the following study (Study 2), all participants provided their informed
 438 consent in a written form before the participation.

439 3.1.2. Results

440 3.1.2.41. Statistical analysis strategy Food choice

441 Overall, 35% of participants chose almonds while 65% chose M&M’s for tasting. In a binary
 442 logistic regression, food choice (0 = “vice”; 1 = “virtue”) was regressed on a cognitive load
 443 dummy (0 = “low”; 1 = “high”), dietary restraint (standardized), and their interaction. The
 444 regression revealed no significant main effect of dietary restraint, $B = .00$, $Wald = .00$, $p = .974$,
 445 but a significant main effect of cognitive load, $B = -.41$, $Wald = 6.12$, $p = .013$, which was
 446 qualified by a significant interaction, $B = .45$, $Wald = 7.15$, $p = .008$. (Replacing dietary restraint
 447 with the other scale measures caused the interaction to drop from significance, $ps > .55$). Follow-

⁵ Note that the reliability for the consumer impulsivity scale was unexpectedly low ($\alpha = .58$).

⁶ For example, the dietary restraint scale includes items such as “How often are you dieting? (0 = never, 1 = rarely, 2 = sometime, 3 = often, 4 = always)”; the consumer impulsivity scale includes “impulsive” (1 = usually would describe me; 7 = seldom would describe me); and the brief self-control scale includes “I am good at resisting temptation (1 = not at all like me; 5 = “very much like me”).

⁷ Factor analysis conducted on each of the scales, using Maximum Likelihood extraction and Varimax rotation, supported the structures of the scales that have been well established in the literature. For the 10-item dietary restraint scale, Barlett’s test of sphericity was significant ($\chi^2(45) = 1426.55$, $p < .001$) and the two-factor structure was revealed (goodness-of-fit $\chi^2(26) = 77.54$, $p < .001$): Factor 1 (Eigenvalue = 3.30) explains 33.01% of variance and factor 2 (Eigenvalue = 1.49) does 14.89%. This is consistent with the literature that has conceptualized and shown two subfactors, namely, concern for dieting and weight fluctuation (Polivy, Herman, and Warsh, 1978; Heatherton et al., 1988). For the 11-item consumer impulsivity scale, Barlett’s test of sphericity was significant ($\chi^2(55) =$, $p < .001$) and the two-factor structure was revealed (goodness-of-fit $\chi^2(34) = 235.60$, $p < .001$): Factor 1 (Eigenvalue = 4.05) explains 32.84% of variance and factor 2 (Eigenvalue = 1.78) does 16.19%. This is consistent with the literature that has conceptualized and shown two subscales, namely, prudent and hedonic (Puri, 1996). Lastly, for the 13-item brief self-control scale, Barlett’s test of sphericity was significant ($\chi^2(78) = 1997.01$, $p < .001$) and a three-factor structure emerged (goodness-of-fit $\chi^2(42) = 127.60$, $p < .001$): Factor 1 (Eigenvalue = 4.12) explains 31.71% of variance, factor 2 (Eigenvalue = 1.38) explains 10.60%; and factor 3 (Eigenvalue = 1.19) explains 9.17%. Past research has revealed both 2-factor (Maloney et al., 2012; Manapat et al., 2019) and 3-factor structures (De Ridder et al., 2011).

analyzing these two variables, we adopted different strategies since food choice is a standalone decision but quantity consumption is conditional on this initial choice. Hence, for the food choice measure, we used a binary logistic regression to test the effect of measured individual differences in self-control and cognitive load on choice. For the post-choice quantity consumption, however, the quantity measure is subject to the issue of self-selection because participants were free to make a choice, not randomly assigned to a specific choice. Put differently, an unobservable factor that is not related to self-control may have influenced choice and quantity simultaneously. quantity consumption using an endogenous treatment regression model (Heckman, 1979, Maddala, 1986) that follows a two-step maximum likelihood estimation. Adoption of this model enables us to analyze the quantity while controlling for a role of unobservable variables that might affect both choice and quantity decisions. This is a common practice in the marketing science literature, analogous to the analysis of purchase quantity conditional on brand choice (Krishnamurthi and Raj, 1988). In a recent consumer psychology application of this method, Galoni and Noseworthy (2015) used it to test whether their participants spent different amounts of money conditional on which aisle of a mock supermarket they chose to shop in (the aisles contained different types of products). WeTo conduct a binary logistic regression, we used the SPSS. To conduct an endogenous treatment regression analysis, we used the *etregress* command in Stata version 17.0. Details of the model specifications will be discussed below.

3.1.2. Results

3.1.2.12. Food choice

Overall, 35% of participants chose almonds while 65% chose M&M's for tasting. In a binary logistic regression, food choice (0 = "vice"; 1 = "virtue") was regressed on a cognitive load dummy (0 = "low"; 1 = "high"), dietary restraint (standardized), and their interaction. The regression revealed no significant main effect of dietary restraint, $B = .00$, $Wald = .00$, $p = .974$ (odds ratio = 1.00), but a significant main effect of cognitive load, $B = -.41$, $Wald = 6.12$, $p = .013$ (odds ratio = .66), which was qualified by a significant interaction, $B = .45$, $Wald = 7.15$, $p = .008$ (odds ratio = 1.56). Replacing dietary restraint with the other scale measures caused the interaction to drop from significance, $ps > .55$. Follow-up spotlight analyses revealed that the effect of cognitive load was significant at 1 SD below the mean of the dietary restraint scale (among unrestrained eaters; $B = -.86$, $Wald = 12.24$, $p < .001$, odds ratio = .43), showing that unrestrained eaters were more likely to choose a vice under high (vs. low) cognitive load ($M_{low} = 60.71\%$ vs. $M_{high} = 78.41\%$). In contrast, imposing high (vs. low) cognitive load did not influence choice at 1 SD above the mean of the restraint scale ($M_{low} = 60.52\%$ vs. $M_{high} = 59.63\%$; $B = .04$, $Wald = .03$, $p = .87$, odds ratio = 1.04). In addition, simple slopes analyses in the high load condition indicated that decreasing dietary restraint was indeed related to a greater propensity to choose the vice, $B = .45$, $Wald = 12.88$, $p < .001$ (odds ratio = 1.57). These patterns replicate those reported by Shiv and Fedorikhin (1999). However, we find moderation only by dietary restraint, not by consumer impulsivity or trait self-control. This may possibly be because Shiv and Fedorikhin (1999) did not use the full consumer impulsivity scale developed by Puri (1996) and because the reliability of this scale was unexpectedly low ($\alpha = .58$). Also, it is possible that dietary restraint is a more specific measure of self-control in the food consumption domain than the others.

3.1.2.23. Quantity consumed in grams

This Endogenous treatment regression estimates a set of predictors for food choice, and a set of predictors for quantity consumed together, and tests whether there is indeed a significant endogeneity due to choice being self-selected. In the equation for choice, cognitive load, dietary restraint and their interaction were used as predictors, as we analyzed the choice measure, while in the equation for quantity consumed, cognitive load, choice, dietary restraint, and all two- and three-way interactions between these variables were used, controlling for subjective hunger and the taste of sampled food (see Supplementary Table 2 in the Supplementary Material file for the details). Control variables were introduced due to their potential impact on intake (Guerrieri et al., 2008; Nederkoorn et al., 2009).

There was a significant endogeneity between food choice and quantity in this case ($\rho = -.76$, $\sigma = 11.21$, $\chi^2(1) = 44.82$, $p < .001$), highlighting the value of using this method. Specifically, controlling for subjective hunger, $B = 1.60$, $z = 8.30$, $p < .001$, and taste of the sampled food, $B = 1.01$, $z = 3.07$, $p = .002$, the regression revealed a significant main effect of choice, $B = 14.68$, $z = 6.89$, $p < .001$, and a significant three-way interaction, $B = -4.01$, $z = -2.66$, $p = .008$. No other main effects or interactions reached significance ($ps > .29$). We conducted simple slopes analyses in order to test the effect of dietary restraint conditional on choice in each cognitive load condition. Critically, in the high cognitive load condition, after having chosen a virtue, increasing dietary restraint was associated with lower quantities consumed, $B = -4.17$, $z = -4.31$, $p < .001$ (see Figure 1). This suggests that despite self-control enactment in the choice stage, those with low dietary restraint rather end up losing self-control in the consumption stage while those with high dietary restraint rather maintain their self-control in the consumption stage. In contrast, after having chosen a vice under high cognitive load, increasing dietary restraint was directionally not significantly associated with lower quantities consumed, $B = -1.29$, $z = -1.80$, $p = .071$ (but see the results on the estimated calorie consumption below). In the low cognitive load condition, dietary restraint did not affect quantity consumed regardless of the chosen option, $ps > .51$. These null results argue for the limitation of using observed choice to infer self-control. Finally, when we replaced the dietary restraint scale with the other general individual difference measures (consumer impulsivity and brief self-control scales, respectively), none of the three-way interactions were significant ($ps > .80$). Finally, we conducted parallel analyses using OLS that does not account for endogeneity, and obtained similar results in terms of patterns and significance levels (See Supplementary Table 3 in Supplementary Material file for details).⁸

[INSERT FIGURE 1 ABOUT HERE]

3.1.2.34. Calorie intake

We analyzed calorific intake using the same endogenous treatment regression model with the same set of predictor equations. While there was no significant endogeneity here, $\rho = -.54$, $\sigma =$

⁸ Note that endogenous treatment regression analysis results do not render statistics that can be used for effect size calculation such as R-squares. Hence, no effect size is provided for the effects shown in the endogenous treatment regressions throughout the manuscript. However, to obtain an approximate effect size, we calculated effect sizes using equivalent OLS regressions and report them in the OLS regressions results in the Supplementary Material.

51.33, $\chi^2(1) = 2.44$, $p = .12$, we accounted for endogeneity in the subsequent analyses (see Supplementary Table 4 in Supplementary Material [file](#)). The regression revealed a significant main effect of choice, $B = 59.40$, $z = 2.15$, $p = .03$, and the significant target three-way interaction, $B = -19.66$, $z = -2.46$, $p = .014$, controlling for subjective hunger, $B = 8.30$, $z = 8.25$, $p < .001$, and taste of the sampled food, $B = 5.07$, $z = 2.92$, $p = .003$. No other effects were significant ($ps > .35$). We again conducted simple slopes analyses within each choice x load condition. Under high cognitive load, after having chosen a virtue, increasing dietary restraint was associated with lower calorie consumption, $B = -19.13$, $z = -3.30$, $p = .001$ (see Supplementary Figure 2 in Supplementary Material [file](#)). However, after having chosen a vice under cognitive load, dietary restraint did not affect calorie intake, $B = -4.58$, $z = -1.13$, $p > .257$. Under low cognitive load, dietary restraint did not influence calorific intake for either virtue or vice choice, $ps > .52$. Again, the other trait measures did not produce any meaningful results (3-way interactions, $ps > .82$). Note that we also conducted parallel analyses using OLS that does not account for endogeneity, and obtained similar results in terms of the patterns and significance levels (Supplementary Table 5 in Supplementary Material [file](#)).

543 3.1.3. Discussion

544 These results ~~point up the stark disparities between~~ demonstrate that self-control can change over
 545 choice and quantity ~~as indicators of self-control related behavior~~ decisions, depending on
 546 ~~individuals' dietary restraint~~. Similar to Shiv and Fedorikhin (1999), in Study 1, we found a
 547 significant interactive effect of cognitive load by dietary restraint on choice of vice vs. virtue.
 548 Unrestrained eaters were far more likely to choose a vice when under cognitive load; load had no
 549 effect for restrained eaters. ~~It seems the~~ The behavior of individuals who have low self-control
 550 (i.e., unrestrained eaters) is well captured by the choice measure under high cognitive load.
 551 ~~However~~ This is a conceptual replication of Shiv and Fedorikhin's (1999) findings. Furthermore,
 552 analysis of quantity consumed tells a ~~very different~~ novel story of dynamic self-control. In the
 553 high cognitive load condition, among those who chose a virtue, decreasing dietary restraint was
 554 associated with increasing quantities consumed and higher calorific intake. In other words,
 555 ~~somewhen~~ unrestrained eaters ~~had indeed behaved as if they were high in successfully enacted~~
 556 self-control ~~in the choice stage~~ by choosing the virtue. ~~However, subsequent to that virtuous~~
 557 ~~choice~~, they exhibited their lack of self-control over actual consumption- ~~by increasing intake of~~
 558 ~~the chosen virtue~~. In contrast, when participants chose a vice, quantity consumed was not
 559 ~~influenced by dependent on their~~ dietary restraint. Study 1 therefore provides evidence that ~~self-~~
 560 ~~control may change across~~ choice and quantity decisions ~~may systematically vary in terms of~~
 561 ~~their reflection of self-control. The inference from observing quantity within a single~~
 562 consumption ~~episode. Also, such a dynamic is that clearly captured when~~ unrestrained eaters
 563 ~~exhibited worse self-control than compare to~~ restrained eaters, but ~~only after a virtue choice-not~~
 564 ~~captured when individual differences are accounted based on general trait self-control or~~
 565 ~~impulsivity.~~

566 Why might this happen? From the observed patterns, we propose that choice behavior itself in
 567 the first stage could influence self-control goal accessibility, depending on dietary restraint.
 568 Specifically, for people with low levels of dietary restraint, merely choosing a virtue ~~seemed to~~
 569 ~~have decreased would decrease~~ accessibility of the self-control goal (Shah, 2005), leading to
 570 higher quantity consumption. Such an effect ~~was would~~ not ~~be~~ observed among people with high
 571 dietary restraint. To investigate this possible mechanism, in Study 2 we examined whether goal

accessibility might play a role across choice and quantity decisions [by measuring post-choice goal accessibility](#).

3.2. Study 2: Post-choice accessibility of the self-control goal

Prior research on goal pursuit across multiple decisions has shown that sufficient progress on a self-control goal due to a prior decision or behavior can lower the activation of the self-control goal, and increase the activation of a conflicting goal (Fishbach and Dhar, 2005, Laran and Janiszewski, 2009, Shah, 2005). For example, when a past instance of restraint is salient, people low in self-control (e.g., impulsive consumers) tend to indulge themselves, and this is due to lowered accessibility of the self-control goal (Mukhopadhyay et al., 2008). Applying this goal accessibility account to the current instance, the act of choosing a virtue [in the choice stage](#) might decrease the accessibility of the self-control goal for unrestrained eaters, [presumably due to their weak interest in controlling food decisions](#)—thereby causing them to eat greater quantities [in the consumption stage](#). In contrast, the same virtue choice should not have this effect for restrained eaters, [but rather they can sustain their self-control in the post-choice consumption stage after making a virtuous choice](#) because they by definition are motivated to regulate food consumption and have a chronically high goal of self-control in this domain. Hence, we predict that after choosing a virtue, more unrestrained eaters should respond more slowly to self-control related words in a lexical decision task.

3.2.1. Method

3.2.1.1. Participants and design

Undergraduate students ($N = 356$, 54.8% female; $M_{\text{age}} = 20.02$) participated in exchange for course credit. As in Study 1, participants freely chose between a vice (M&M's) and a virtue (almonds), and their dietary restraint ($\alpha = .77$) was measured.

It is worth noting that in Study 1 we observed our focal effects under high cognitive load, but in this study, we did not limit processing resources. This is because activation of self-control goals (as opposed to behaviors) is not affected by availability of cognitive resources. Prior research found no difference in accessibility of goals that are relevant to self-control between high and low cognitive load conditions (Fishbach et al., 2003). Hence, to avoid further complicating the already complex procedure, we did not constrain processing resources in [this Study](#).

3.2.1.2. Procedure

This study was presented as a study on visual processing and taste perception. Participants were run in groups of up to nine at a time. All participants were seated at individual workstations, and first chose a food and then performed a lexical decision task. The procedure for the food choice was similar to Study 1, but with some important differences. Each participant was presented with almonds and M&M's, side by side in separate transparent plastic cups (see Supplementary Figure 3 in the Supplementary Material [file](#)). The cups were sealed with a transparent lid to prevent participants from taking and tasting any. After everyone had indicated their choice, the sealed bowl containing the chosen option was placed right below the computer screen, directly in front of the participants, who were asked to proceed to the lexical decision task (see Supplementary Figure 4 in the Supplementary Material [file](#) for the setting for this task).

612 The lexical decision task (conducted on DirectRT version 2010.2) was disguised as a visual
 613 processing task. Participants were instructed to identify whether the letter string on the screen
 614 was a word or a non-word by pressing the yellow key for a word (yellow dot sticker on key C) or
 615 the green key for a non-word (green dot sticker on key N). They were instructed to respond as
 616 accurately and fast as possible. After 5 practice trials, they did 40 trials, of which 5 words were
 617 related to self-control (fit, health, diet, weight, and slim), 5 were related to indulgence (delicious,
 618 indulge, eat, yummy, tasty), 10 words were neutral (balloon, desk, folder, picture, shoe, printer,
 619 sink, pen, card, wall) and there were 20 non-words (Fedorikhin and Patrick, 2010, Laran, 2010b,
 620 Laran, 2010a, Wilcox et al., 2009). The presentation order of trials was randomized. In each trial,
 621 the fixation point (+) was presented for 1000 milliseconds, and was followed by a target.

622 Following the lexical decision task, the experimenter informed participants that the tasting task
 623 was cancelled due to time constraints, and they had to continue to the surveys on their PC. The
 624 experimenter collected the food cups from each participant while ensuring that no one had
 625 consumed any- [during the study](#). Participants then worked on filler tasks for around 20 minutes,
 626 then responded to ~~the~~ dietary restraint [scale \(10-item, \$\alpha = .77\$ \)](#), consumer impulsivity scale (11-
 627 [item, \$\alpha = .63\$ \)](#), and ~~other individual difference measures~~ [brief self-control scale \(13-item, \$\alpha = .82\$ \)](#)
 628 as in Study 1.⁹ Descriptive statistics and correlations among measured variables are reported in
 629 Supplementary Table 6 in the Supplementary Material [file](#).¹⁰

630 ~~3.2.2. Results~~

631 ~~3.2.12.31. Statistical analysis strategy~~

632 [This study has two types of dependent variables of interest: \(1\) food choice and \(2\) goal](#)
 633 [accessibility measures for a self-control goal and an indulgence goal. For the food choice](#)
 634 [measure, we adopted the same analysis strategy as in Study 1, using binary logistic regression](#)
 635 [\(this study did not feature a cognitive load factor\). For the goal accessibility measures](#)

⁹ Factor analysis was again conducted with the measured scales in the same manner as in Study 1. Again, the results are consistent with the known structures of the scales. For the 10-item dietary restraint scale, Barlett's test of sphericity was significant ($\chi^2(45) = 713.07, p < .001$) and the two-factor structure was shown (goodness-of-fit $\chi^2(26) = 40.45, p = .035$): Factor 1 (Eigenvalue = 3.30) explains 32.99% of variance and factor 2 (Eigenvalue = 1.44) does 14.39%. This is consistent with prior literature as well as the results of Study 1. For the 11-item consumer impulsivity scale, Barlett's test of sphericity was significant ($\chi^2(55) = 1395.26, p < .001$) and the two-factor structure was shown (goodness-of-fit $\chi^2(34) = 130.66, p < .001$): Factor 1 (Eigenvalue = 4.18) explains 37.97% of variance and factor 2 (Eigenvalue = 1.70) does 15.44%. Again, this is consistent with Study 1 and prior literature. Lastly, for the 13-item brief self-control scale, Barlett's test of sphericity was significant ($\chi^2(78) = 1117.95, p < .001$) and the three-factor structure emerged (goodness-of-fit $\chi^2(42) = 70.88, p = .004$): Factor 1 (Eigenvalue = 4.19) explains 32.20% of variance, factor 2 (Eigenvalue = 1.46) does 11.22%; and factor 3 (Eigenvalue = 1.22) explains 9.35%. This is similar to the structure found in Study 1 and De Ridder et al. (2011).

¹⁰ Detailed results of the analysis with brief self-control scale and consumer impulsivity scale are not reported here for they are no longer the focus of this study and there were no significant effects with these scales.

(facilitation scores), since food choice was self-selected as before, we adopted endogenous treatment regression to analyze each measure separately. The same statistical software was used for these analyses as in the Study 1. Details of the model specifications are discussed below.

3.2.2. Results

3.2.2.12. Food choice

Similar to Study 1, 30.6% of participants chose the virtue and 69.4% chose the vice. In a binary logistic regression, we regressed choice (0 = “vice”; 1 = “virtue”) on dietary restraint. ~~DietaryAs we did not manipulate cognitive load in this study, dietary~~ restraint did not influence choice likelihood, $B = -.15$; $Wald = 1.63$; $p = .20$; (odds ratio = 1.16), consistent with the low cognitive load condition of Study 1.

3.2.2.23. Facilitation scores from response latencies

Before analyzing response latencies, the data were prepared by dropping false responses (3.6% of all responses) that misidentified the targets, due to difficulty in interpreting such incorrect responses (Bargh et al., 1992). Further, we excluded latencies that were ~~greater~~ faster than 300 milliseconds or slower than 2000 milliseconds (.5% of all responses), following prior practices (Anderson et al., 1998, Leibold and McConnell, 2004, Mukhopadhyay et al., 2008)). As a measure of relative accessibility of a target goal compared to neutral words, we constructed facilitation scores by subtracting the average response time for words of the target category from the average response time for neutral words (Anderson et al., 1998, Finkelstein and Fishbach, 2010, Förster et al., 2005, Leibold and McConnell, 2004). Greater facilitation scores mean faster responses to the target category, suggesting higher accessibility of the target goal. Two facilitation scores were constructed for each participant: one for the self-control goal, the other for the indulgence goal.

~~Since food choice was self-selected, we used an endogenous treatment regression model as before.~~ We conducted separate endogenous regression analyses for the two different facilitation scores. ~~In the regression for~~ For choice, dietary restraint was the predictor. ~~Then and for facilitation scores,~~ the target facilitation score was regressed on choice, dietary restraint, and their interaction. For the facilitation score for self-control, the analysis revealed significant endogeneity, $\rho = .75$, $\sigma = 84.30$, $\chi^2(1) = .11.41$, $p = .001$ (See Supplementary Table 7 in the Supplementary Material ~~file~~). Accounting for this, there was a significant main effect of choice, $B = -106.61$, $z = -3.79$, $p < .001$, an insignificant effect of dietary restraint, $B = .64$, $z = .15$, $p = .88$, and a significant interaction, $B = 16.85$, $z = 2.41$, $p = .016$. Simple slopes analyses revealed that when the vice was chosen, dietary restraint did not affect facilitation of self-control, $B = .64$, $z = .15$, $p = .88$ (see Figure 2A). However, when the virtue was chosen, dietary restraint significantly affected self-control facilitation, $B = 17.49$, $z = 2.92$, $p = .004$. This supports our prediction in that after virtue choice, ~~less restrained eaters~~ participants with low dietary restraint responded slower to words related to self-control compared to those with high dietary restraint—self-control was ~~no longer as~~ less accessible for them.

[INSERT FIGURE 2 ABOUT HERE]

675 Analysis of the facilitation score for the indulgence goal revealed no significant endogeneity, $\rho =$
 676 $-.18$, $\sigma = 85.65$, $\chi^2(1) = .91$, $p = .341$ (See Supplementary Table 8 in the Supplementary Material
 677 [file](#)). Moreover, no effects were significant (choice, $B = 28.36$, $z = 1.00$, $p = .32$, dietary restraint,
 678 $B = -.53$, $z = -.10$, $p = .92$, interaction, $B = 10.39$, $z = 1.30$, $p = .19$) (see Figure 2B). All the
 679 above patterns remained similar when analyses were conducted using standard OLS (see
 680 Supplementary Table 9 in the Supplementary Material [file](#)). Additionally, replacing dietary
 681 restraint with the other trait measures reproduced none of the above results (i.e., ps of choice x
 682 trait scales $> .3$).

683 3.2.3. Discussion

684 These results provide strong and convergent support for our propositions [based on goal](#)
 685 [accessibility account for the dynamic of self-control](#). After having chosen a virtue, unrestrained
 686 eaters showed decreased accessibility of words related to self-control, supporting our goal-
 687 accessibility based prediction. However, [for restrained eaters](#), even after having chosen a virtue,
 688 a self-control [goal](#) remained [highly](#) accessible [for restrained eaters](#). We can infer that this
 689 difference in goal accessibility would have contributed to the observed differences in [the post-](#)
 690 [choice](#) quantity consumption (Belei et al., 2012). In Study 1, unrestrained eaters who chose a
 691 virtue may have satisfied their self-control goal [by their choice behavior](#), leading to a backfire
 692 effect as evidenced by increased consumption of the chosen virtue. In contrast, among those who
 693 chose a vice, dietary restraint did not affect the accessibility of self-control. This result is
 694 consistent with the quantity patterns we observed in Study 1, where we found no effect of dietary
 695 restraint after a vice choice.

696 Why did we not observe any significant effects for the accessibility of indulgence? It is possible
 697 that the choice context itself, consisting of a vice and a virtue presented side by side, can
 698 suppress activation of the indulgence goal regardless of one's decision. This is consistent with
 699 Fedorikhin and Patrick's (2010) observation that when actual vice and virtue options (M&M's
 700 and grapes) were presented (vs. not), the accessibility of self-control was increased but that of
 701 indulgence was decreased.

702 4. General Discussion

703 [Although self-control plays a role in both choice and quantity, and food consumption also](#)
 704 [follows a similar two-stage process, most research in self-control has looked only at choices](#)
 705 [between vices and virtues](#). By examining choice and post-choice quantity together, this research
 706 highlights the [drawback/benefit of using observed/observing post-choice consumption behavior](#)
 707 [following choices alone to infer self-control](#). Ironically, [after/understand the dynamic of self-](#)
 708 [control within a consumption episode. After successful enactment of self-control by making a](#)
 709 [virtuous choice, more](#) unrestrained eaters ate greater quantities and consequently more calories
 710 [compared to their restrained counterparts](#), if their processing resources were limited (Study 1).
 711 While successfully choosing a virtue is one indication of high self-control, [a consideration of in](#)
 712 [the subsequent quantity consumed appeared to belie this inference/decision stage, their self-](#)
 713 [control is not always sustained in the post-choice consumption stage](#). Particularly, dietary
 714 restraint [had a pronounced effect on quantity consumed/determined persistence of self-control](#)
 715 [exercise during the post-choice consumption stage](#) among people who chose a virtue. [This shows](#)
 716 [changes in self-control exercise across choice and consumption stages](#). In contrast, among those

717 who chose a vice, dietary restraint did not systematically influence consumption quantity. This
 718 suggests that although those who chose a vice failed to enact self-control in the choice stage,
 719 they did not end up eating too much of the chosen vice. We further examined the underlying
 720 mechanism for this effect by measuring post-choice goal accessibility (Study 2). After having
 721 chosen a virtue, decreasing dietary restraint was associated with lower accessibility of the self-
 722 control goal, suggesting that the choice of a virtue deactivates self-control thereby increasing
 723 consumption quantity among unrestrained eaters. Together, the result suggests that in the
 724 common consumption context where consumers make a food choice first and then decide how
 725 much to consume the chosen food, self-control can operate dynamically across choice and
 726 quantity decisions, depending on individuals' motivation in dietary regulation. Notably, while
 727 self-control in the consumption stage is lost for unrestrained eaters when they successfully
 728 exercised self-control in the choice stage, such a lapse in the consumption stage is not similarly
 729 observed when they failed to exert self-control in the choice stage. Presumably, because the post-
 730 choice consumption stage usually allows for a longer duration for the consumption decision,
 731 those who initially exhibited a self-control lapse by choosing a vice, regardless of their dietary
 732 restraint, might be better able to recover from their self-control lapse by taking time to correct
 733 their decision and moderate their intake of the chosen vice.

734 Note that in our experimental settings in both studies, participants were instructed to make food
 735 consumption decisions to taste, which might be different from decisions to consume in general.
 736 Hence, to test whether our design is susceptible to such a problem, we conducted a post-hoc test
 737 ($N = 201$, 50.2% female, $M_{age} = 40.53$; American participants recruited from Amazon
 738 Mechanical Turk) in which we asked two questions that only differ in the 'consume'/'taste'
 739 wording in the questions: "Imagine you have a choice between M&M's and almonds for
 740 consumption/tasting. If you chose to consume/taste M&M's instead of almonds, how much
 741 would you think it is reflective of your self-control?" (1 = very low self-control; 7 = very high
 742 self-control). The two questions were counterbalanced. Paired samples t-test revealed that
 743 participants did not give different ratings between the consumption decision ($M = 3.54$) and the
 744 tasting decision ($M = 3.67$; $t(200) = 1.68$, $p = .095$). Also, notably, we separately ran a one-
 745 sample t-test to check whether the rating was below the mid-point, which would suggest that the
 746 decision to consume/taste M&M's over almonds is indicative of low self-control. Indeed, the
 747 results support the idea that both decisions, for consumption ($t(200) = -3.94$, $p < .001$) and for
 748 tasting ($t(200) = -2.88$, $p = .004$), were perceived as relatively low self-control. The results
 749 ensure the generalizability of our findings to consumption.

750 4.1. Theoretical contributions

751 Shiv and Fedorikhin's (1999) seminal research triggered a wave of research in self-control, much
 752 of which was based on one of their key propositions, namely, that ~~lowered self-control leads~~
 753 ~~systematically to an increased probability of choosing a virtue over a vice.~~ However, our two-
 754 stage analysis demonstrates that inferring self-control from merely observing choice between a
 755 vice and a virtue yields an incomplete picture of the operation of self-control. Quantity decisions
 756 are a critical and integral part of the self-control dilemma, and the "construct-to-construct link"
 757 (Lynch Jr et al., 2012) between self-control and choice that ignores quantity is likely to be
 758 erroneous. Essentially, ignoring quantity in a test of a self-control related theory implies that the
 759 theory may not have been fully and accurately tested.

760 Based on the goal accessibility account, our finding suggests that unrestrained eaters might
 761 perceive their virtue choice as progress towards a self-control goal (Fishbach and Dhar, 2005,
 762 Laran, 2010a, Mukhopadhyay et al., 2008). Presumably, this perception of progress caused by
 763 the act of choosing a virtue leads unrestrained eaters to relax control over how much they eat
 764 (Louro et al., 2007), or to take their choice as a license for consuming more quantity (Khan and
 765 Dhar, 2006, Mukhopadhyay and Johar, 2009). Restrained eaters, in contrast, maintain the
 766 accessibility of self-control even after a virtue choice, which ~~prevents~~ makes them ~~from~~ sustain
 767 their self-control without over-consuming. While we find evidence for this goal-accessibility-
 768 based mechanism, the patterns of behaviors we observe are consistent with other mechanisms.
 769 For example, unrestrained eaters might have consumed larger quantities of the chosen virtue
 770 under high cognitive load because they perceived its taste to be better (Van Der Wal and Van
 771 Dillen, 2013), perceived large serving sizes to be more appropriate (Provencher et al., 2009),
 772 underestimated the calorie content of the virtue (Chandon, 2007), or perceived virtuous foods as
 773 being light (Deng et al., 2011). Possibly, several mechanisms may work simultaneously.
 774 Nonetheless, we found over-consumption of the chosen virtue only in high cognitive load
 775 conditions, which may make it difficult for consumers to generate further inferences during their
 776 consumption. Thus, other mechanisms that rely on further inferences (e.g., appropriate size;
 777 calorie estimation) might be less likely to contribute to unrestrained eaters' increased virtue
 778 consumption.

779 A third contribution of this research is in introducing endogenous treatment regression models to
 780 the self-control literature. As mentioned, these models are fundamental to the marketing science
 781 literature, where they were introduced to answer the question, given a consumer chooses a given
 782 brand, how much does s/he buy? For example, price discounts may induce brand switching
 783 and/or increased purchased quantity, therefore it is important to understand both effects jointly.
 784 Similarly, in the consumer psychology literature, a 2-stage estimation model is used to account
 785 for self-selection to investigate whether people who had been randomly given either clean new
 786 bills or dirty, crumpled, money chose to spend that money on cleaning products or office
 787 supplies, and how much they then spent (Galoni and Noseworthy, 2015). Our research follows a
 788 very similar estimation method, and we hope that other consumer psychologists and self-control
 789 researchers will adopt similar models which have been designed to address questions of this
 790 nature; which is inevitable in the design.

791 **4.2. Trait measures related to self-control**

792 Why did dietary restraint have an effect on quantity consumed and goal accessibility across our
 793 studies, but never the other measures of trait self-control? There are several possibilities. The
 794 most straightforward is that a domain-specific measure of self-control is more predictive of
 795 behaviors than general self-control scales (Haws et al., 2016). Self-control operations are
 796 domain-specific (Metcalf and Mischel, 1999), and it may simply be the case that the general
 797 scales we used were not sensitive enough to capture the effects, particularly on post-choice
 798 quantity.

799 Over and above measurement issues, domain-specificity is also implicated if one were to try and
 800 understand our observed patterns in terms of motivation rather than ability to self-control. Self-
 801 control motivation can lead to internal conflict which increases resistance to temptations
 802 (Hofmann et al., 2012), but the outcome of high motivation is not always high self-control

803 behaviors. In contrast, the outcome of high ability to self-control is, by definition, increased
 804 restraint. In this research, we operationalized domain-specific self-control motivation as dietary
 805 restraint. This is because restrained eaters are known to have a strong conflict between their
 806 desires for tasty foods and a chronic goal to restrict their diet (Stroebe et al., 2013, Van Der Laan
 807 et al., 2014). Depending on the relative forces of these two goals, restrained eaters may behave
 808 either consistently or inconsistently with their self-control motivation (Stroebe et al.,
 809 2013). Indeed, restrained eaters exhibit stronger resistance against tempting foods (Hofmann et
 810 al., 2014). As unrestrained eaters lack such a motivation to control food intake, their self-control
 811 operates in a less persistent manner across choice and quantity decision stages than restrained
 812 eaters, particularly once they have already exercised self-control in the choice stage.

813 Additionally, a difference between restrained eaters' and unrestrained eaters' exercise of self-
 814 control over choice and quantity decisions can be considered as a difference arising from self-
 815 control exercised through resolve versus suppression (Ainslie, 2021). Resolve enables more
 816 enduring and persistent self-control exercise success compared to suppression that helps exercise
 817 of self-control with effort and thus, is difficult to be sustained. Restrained eaters due to their
 818 chronic motivation to control their intake might help them become adept at exercising self-
 819 control without much effort via resolve whereas unrestrained eaters, lacking ongoing motivation
 820 to persist dietary regulation, might only exercise self-control via suppression with a great deal of
 821 effort. As a result of differing effort levels required for self-control enactment in the choice stage
 822 for a virtuous choice, their trajectories of self-control persistence might start to diverge from the
 823 post-choice stage.

824 4.3. Limitations and future research

825 The current research has several limitations. First, due to the time constraints in the lab,
 826 participants were only allowed to consume their chosen food for a predetermined limited time.
 827 They may well have eaten more if given more time – although that argument applies across all
 828 conditions. Second, for purposes of control and tractability, we adopted the same stimuli across
 829 studies, with M&M's and almonds representing vices and virtues respectively. Future research
 830 should check whether the discrepant findings between dynamic operation of self-control across
 831 choice and quantity decisions are robust across different foods.

832 Second, the different tastes of vices and virtues (e.g., sweet, fat, and salty tastes) may impact
 833 food liking and satiety differently (Drewnowski and Schwartz, 1990; Bolhuis, Costanzo, &
 834 Keast, 2018), and such inherent differences are unavoidable in the current research design. We
 835 try to address this issue partially by controlling for the taste of the sample food as rated by
 836 individual participants. Also, as food intake is influenced by numerous transitory factors such as
 837 hunger level and food variety in the environment (Nederkorn et al., 2009; Guerrieri et al., 2008),
 838 we also controlled for subjective hunger level of participants in Study 1. However, this cannot
 839 completely rule out the potential impact of unmeasured transitory factors on food decisions in the
 840 current studies.

841 There is also a question of domain-specificity. ~~One~~ of dynamic operation of self-control. To
 842 understand the operation of self-control, our studies were conducted in the domain of food, but
 843 we believe the implications of our results are not restricted to food alone. Food has been the
 844 modal domain in self-control research, but similar choice measures have been used to

845 ~~infer~~examine dynamic self-control operation in other product categories. For example, Milkman,
 846 Rogers and Bazerman (2009) studied rentals of educational versus entertaining videos, and
 847 Mukhopadhyay and Yeung (2010) used the same category in two experiments to assess parents'
 848 and adult caregivers' choices for children. While documentaries versus action flicks certainly
 849 satisfy the criteria for serving as relative virtues versus vices, we believe that binge-watching the
 850 History Channel might well be too much of a "good" thing- and individuals' self-control relevant
 851 to the entertainment domain may underlie such a case of lost self-control in the post-choice
 852 stage. Excessive virtuous behaviors might be damaging because prolonged delay of gratification
 853 (e.g., nonstop work without leisure) can harm wellbeing (Grant and Schwartz, 2011). As a more
 854 extreme example, hand-washing is a virtuous behavior because it reduces the risk of infection,
 855 but compulsive hand-washing is a manifestation of obsessive-compulsive disorder (Hinds et al.,
 856 2012). Whether post-choice consumption "quantity" measures follow similar patterns in other
 857 domains is an empirical question we leave for future research.

858 The ~~consumption results~~dynamic operation of self-control across choice and quantity decisions
 859 was observed only under high cognitive load ~~suggest~~. This suggests that the self-control process
 860 that drives ~~continued~~ eating is relatively unconscious, but our results do not definitively indicate
 861 when and how consumers decide their intake quantities. As we proposed, the goal accessibility
 862 that is influenced by an act of choice can play a role in quantity decisions. Furthermore,
 863 however, once consumers start eating, it is possible that ~~low-level~~external influences such as
 864 sensory stimulations from eating (e.g., Drewnowski and Schwartz, 1990) might override initial
 865 intentions to control consumption. Since both ~~low-level non-conscious and high-~~
 866 ~~level~~unconscious and conscious processes can affect self-control over consumption decisions
 867 (Williams and Poehlman, 2017), future research should explore how post-choice consumption is
 868 shaped ~~at~~by multiple levels of processingprocesses that vary in consciousness.

869 Finally, one may criticize our fundamental analysis strategy on the grounds that observing
 870 quantity consumption contingent on choice is susceptible to problems of self-selection. In
 871 response, it is important to note that our analyses are always conducted *within* a chosen option –
 872 given a choice of vice or virtue, we find differences in quantities consumed based on dietary
 873 restraint and cognitive load. More generally, as we have stated, this "limitation" is a feature of
 874 the research question, not a bug. The endogenous treatment regression model we use has been
 875 developed for this very purpose. Such models are fundamental to marketing science for the last
 876 three decades, and have been in use in econometrics for even longer (Heckman, 1979). Indeed,
 877 the model we use is primitive enough that it is available in a commonly used statistical software
 878 package. Our results show that self-selection is not always a problem in such cases, and when it
 879 is, it can be accounted for statistically.

880 4.4. Conclusion

881 This research highlights the potential limitations of the popular vice versus virtue food choice as
 882 a measure of self control. We argue that despite its popularity, choices of vices or virtues cannot
 883 be simply interpreted as consequences of low or high self control. First, some consumers may
 884 make this decision without any conflict related to self control. More critically, food consumption
 885 behavior consists of two stages, choice followed by consumption, and inferences made from
 886 observing choice alone may not be generalizable to consumption. Indeed, we find that
 887 consumption patterns tell a very different story regarding self control from what may be inferred

888 ~~by changing the choice stage. In the choice stage, when processing resources were constrained, whether~~
889 ~~participants continued successful self-control enactment after their initial choice, depended on~~
890 ~~their dietary restraint. Among those who exhibited self-control in their virtue choice, decreasing~~
891 ~~dietary restraint was associated with increasing consumption quantities and consequently higher~~
892 ~~caloric intake. Also, those who exhibited a self-control lapse as evidenced by their vice choice~~
893 ~~showed moderated intake of the chosen vice, regardless of their dietary restraint, indicating that~~
894 ~~lost-self-control in the choice stage does not always lead to continued self-control lapse in the~~
895 ~~consumption stage.~~ ~~This change in self-control across choice and quantity decisions has been~~
896 ~~missneglected in the extant literature due to forgoneless investigation of the post-choice~~
897 ~~consumption stage. Also, we demonstrate that the accessibility of the self-control goal at the~~
898 ~~post-choice stage contributes to the systematic discrepancy between changes in self-control over~~
899 ~~choice and quantity decisions.~~

902 A true understanding of self-control must necessarily consider its dynamics over choice and
903 subsequent quantity as well as choice decisions.

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1144 **Figure Captions**

1145 **Figure 1. Quantity Consumed in Grams as a Function of Cognitive Load, Food Choice, and**
1146 **Dietary Restraint in Study 1.**

1147 **(A) High cognitive load. (B) Low cognitive load.**

1148 *Note.* Estimates plotted based on raw dietary restraint scores (range: 0-35).

1149 **Figure 2. Facilitation Scores for Self-Control Goal and Indulgence Goal as a Function of**
1150 **Food Choice and Dietary Restraint in Study 1.**

1151 **(A) Self-control goal facilitation score. (B) Indulgence goal facilitation score.**

1152 *Note.* Estimates plotted based on raw dietary restraint scores (range: 0-35).

1153 5 Manuscript Contribution to the Field

1154 Much research in self-control involves studying choices between virtues and vices, often in food
 1155 (e.g., chocolate cake vs. fruit salad), assuming that researchers can infer one's self-control from
 1156 such a choice. In reality, consumers often make such choices, after which they decide how much
 1157 to consume of the chosen option. The latter post-choice consumption decision is not only integral
 1158 to also reflective of ongoing self-control processes but also critical in determining important
 1159 consumer outcomes (e.g., calorie intake). However, the interdependence of consumption quantity
 1160 on choice, within a single consumption episode, has remained unexamined in the literature in
 1161 examining consumers' self-control. To provide a more comprehensive understanding of dynamic
 1162 self-control operation, this research examines how consumers' self-control plays a role across
 1163 food choice and post-choice consumption stages. Also, by adopting a statistical model that
 1164 simultaneously accounts for both choice and quantity, the authors find that only using a choice to
 1165 infer the implications of while self-control may be systematically different from the implications
 1166 according to is enacted in the choice stage by a virtue choice, self-control is not always sustained
 1167 in the post-choice quantity consumed stage, particularly depending on individual differences in
 1168 dietary restraint. Specifically, restrained eaters sustain their self-control better in term of
 1169 moderated intake of the chosen virtue than unrestrained eaters. We, therefore, caution highlight
 1170 that to understand the popular practice of inferring self-control from choice alone may well be
 1171 insufficient in understanding the dynamic operation of self-control within a consumption episode,
 1172 and, investigation of post-choice quantity decisions are within a consumption episode is critically
 1173 informative.

1174 6 Conflict of Interest

1175 The authors declare that the research was conducted in the absence of any commercial or
 1176 financial relationships that could be construed as a potential conflict of interest.

1177 7 Author Contributions

1178 GO and AM contributed to conceptualization and design of the studies. GO carried out the data
 1179 collection with research assistants and performed the data analysis under AM's supervision. GO
 1180 drafted the first manuscript and GO and AM contributed to revisions of the manuscript. All
 1181 authors approved the submitted version.

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1189 9 Ethical Statement

1190 The Human Participants Research Panel at Hong Kong University of Science and Technology
1191 has reviewed and approved the proposed safety measures for the proposal before the data
1192 collection. Participants indicated their informed consent in a written form.

1193 **10 Data availability statement**

1194 The raw data supporting the conclusions of this article will be made available by the authors
1195 upon request, without undue reservation.

1196 **11 Supplementary Material**

1197 The Supplementary Material for this article is submitted and will be available online.