MODELING APPROACH MOTIVATION IN TERMS OF PERCEPTUAL BIASES INVOLVING APPETITIVE STIMULI

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Modeling Approach Motivation in Terms of

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

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ABSTRACT

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Accumulating evidence suggests a potential relationship between approach motivation and perceptual enhancement. The current investigation was undertaken with the goal of exploring the causes of the phenomenon as well as implications for personality. Below, a model is introduced to help explain the causes and consequences of relations between approach motivation and perceptual size. Two studies are then presented testing a number of assumptions made by the model. In Study 1 (n = 78), state-related variations in approach motivation were manipulated with the intent of sensitizing the perceptual system to appetitive stimuli. It was predicted that such sensitization would result in greater size estimations. In Study 2 (n = 123), size overestimates were used to assess relations between daily events and outcomes. It was hypothesized that individual differences in size estimations for appetitive words (relative to neutral words) would predict daily motivations, emotion, and behaviors, as well as reactivity to daily events. In addition, several individual difference variables ostensibly related to dopamine activity were assessed in both studies and entered as moderators of the degree to which size overestimations varied by stimulus type. Many of the hypotheses were not supported, but size overestimations did, as hypothesized, moderate relations between positive events and goal-related motivation.

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DEDICATION

For Tricia: My wife, my closest confidant, my best friend. I love you.

TABLE OF CONTENTS

ABSTRACT iii

ACKNOWLEDGEMENTS iv

DEDICATION v

LIST OF TABLES ix

LIST OF FIGURES x

INTRODUCTION 1

Re-Conceptualizing Motivation-Perception Relations 4

A Dopamine Inspired Model of Approach Motivation and Perception 5

Current Studies 7

STUDY 1 8

Method 8

Participants 8

Apparatus and General Procedures 9

Motivation Manipulation 9

Perceptual Task 10

Self-Reported Personality Questionnaires 12

Predictions 13

Results 14

Discussion 18

STUDY 2 21

Method 21

Participants 21

Apparatus and General Procedures 22

Perceptual Task 23

Self-Reported Personality Questionnaires 24

Daily Survey 25

Results 26

Initial Results 26

Results Involving Daily Outcomes 28

Discussion 31

GENERAL DISCUSSION 33

Problematic Results 33

Tentative Support 35

Future Directions 36

Concluding Remarks 37

REFERENCES 38

APPENDIX A. WORDS USED IN THE SIZE-ESTIMATION TASK 45

APPENDIX B. PERSONALITY ASSESSMENTS 46

Novelty Seeking 46

Sensitivity to Reinforcement of Addictive and Other Primary Rewards 47

Achievement Seeking 48

APPENDIX C. DAILY ASSESSMENT 49

Daily Achievement Motivation and Motivation to Overcome Obstacles 49

Daily Appetitive Thoughts 49

Daily Positive Affect 49

Daily Impulsive Behavior 50

Daily Positive Events 50

Daily Goal Persistence 50

LIST OF TABLES

Table Page

1. Descriptive Statistics for Study 1 14
2. Results for Word Type x Condition x Individual Difference Interactions 15
3. Results for Word Type x Dopamine Interactions, Study 1 17
4. Descriptive Statistics for Study 2 27
5. Results for Word Type x Dopamine Interactions, Study 2 28
6. Fixed Effects for Initial MLM Analyses 29
7. Fixed Effects For Cross Level Interactions 30

LIST OF FIGURES

Figure Page

1. Proposed model of the relationship between approach stimuli, perceptual size, and approach behavior 6
2. Estimated means for the Writing Condition x Word Type x Achievement Seeking interaction 16
3. Font Bias as a function of Word Type, Study 1 17
4. Estimated means for the Word Type x Novelty Seeking interaction 18
5. Screen shot for Study 2 size estimation task 24
6. Font Bias as a function of Word Type, Study 2 28
7. Graphs for significant cross level interactions 31

INTRODUCTION

It is not uncommon for scientific trends to follow cyclical patterns: ideas are introduced, then dismissed or forgotten, before eventually being rediscovered and used to make important contributions to science. A number of ideas central to what became known as the New Look appear to have taken a similar path. One of the more promising topics first explored by the New Look - and currently the focus of renewed interest - is the relationship between motivational value and perceptual size. Past and present research has shown that appetitive stimuli (i.e., those that should trigger approach motivation) appear larger than neutral or aversive stimuli (Aarts, Custers, & Veltkamp, 2008; Balcetis & Dunning, 2006, 2010; Beams, 1954; Bruner & Goodman, 1947; Gilchrist & Nesberg, 1952; Postman, Bruner, & McGinnies, 1948; Veltkamp, Aarts, & Custers, 2008). Modern thought suggests that it may be profitable to interpret effects of this type from a deeper theoretical perspective, emphasizing non-conscious influences on goal pursuit and the manner in which such processes are linked to individual differences in motivational tendencies.

The first paper presenting research specifically designed to investigate such relations was published by Bruner and Goodman in 1947. In their study, children from different economic backgrounds were asked to adjust a circle of light until it matched the size of various coins and cardboard disks. There was a general tendency among these children to overestimate the size of the coins relative to the disks, with the amount of overestimation covarying with the monetary values of the coins. Importantly, this tendency was exaggerated among poor children, providing support for the idea that value and perception may be systematically related.

The validity of this finding was soon strengthened by research showing that the size-value relationship was not restricted to coins, and that it could be manipulated by changing the value of the object. Lambret, Solomon, and Watson (1949) found that children conditioned to associate a token with reward believed the token was larger than did children who had been exposed to the token but did not receive any conditioning. Moreover, when the tokens were no longer associated with reward, the difference in size perception between groups was eliminated, only to return when the token-reward relationship was reinstated. These findings give significant weight to the claim that value plays an important role in perception.

Despite the initial enthusiasm of these early proponents of the New Look, numerous issues led to its eventual abandonment. Some of these issues can be found in many areas of research, such as poorly designed studies (Klein, Schlesinger, & Meister, 1951; Postman, 1953), poorly defined constructs (e.g., an imprecise definition of "perception": Bruner & Klein, 1960; Goldiamond, 1958; Saugstad, 1966), and inconsistent results (Carter & Schooler, 1949; Jenkin, 1957; Klein et al., 1951). However, it appears that one of the biggest problems was the lack of any particular theory and/or model to guide future research (Goldiamond, 1958; Prentice, 1956; Tajfel, 1957).

Lacking formal models to tie the ideas of the New Look together, by the mid to late 1950s the movement was in a state of disarray. Soon, psychodynamic authors muddied the water with implausible interpretations of such phenomena, including id-based fantasies (Tajfel, 1957). In addition, as psychology became more cognitive, psychologists viewed perception as a psychologically uninteresting topic (Barsalou, 2008). Unfortunately, such developments meant that some phenomena that could be replicated reliably were no longer

pursued. Several attempts were made to bring the central ideas of the New Look back to main stream psychology, but they continued to ground themselves in previous New Look theory and were largely unsuccessful (Bruner & Klein, 1960; Erdelyi, 1974; Greenwald, 1992). Although affect continued to be an area of interest, it was generally viewed in terms of instigating approach or avoidance behaviors rather than their associated perceptions (Murphy, 1956).

There is a need for revisiting the essential wisdom of the New Look, particularly its insistence that motivation, affect, and cognition interact in systematic ways. Consistent with this point, modular ideas of the separation between affect, cognition, and perception have increasingly been criticized (Barsalou, 2008; Baumeister, Vohs, DeWall, & Zhang, 2007; Duncan & Feldman Barrett, 2007; Pessoa, 2008). Emerging evidence has begun to suggest that many brain regions previously believed to operate in a modular fashion are actually highly interconnected in their functioning (Berridge & Kringelbach, 2008; Duncan & Feldman Barrett, 2007; Pessoa, 2008). This idea of interconnectedness has received growing support in brain imaging research (Duncan & Feldman Barrett, 2007) and has been integrated into some computational models of brain functioning (Bundesen, Habekost, & Kyllingsbæk, 2005).

This shift in thinking has been accompanied by research directly examining relations between affect, motivation, and perception. Moreover, there has been a revival of demonstrations of the New Look type. Balcetis and Dunning (2006) found that individuals motivated to perceive an ambiguous figure in a certain manner differentially did so. Changizi and Hallo (2001) found that thirsty individuals perceived a surface to be more transparent, presumably because transparency is a key feature of water. Veltkamp and

colleagues (2008) have shown that objects subliminally paired with positive affect are seen as being larger. In my own research, I have found that positive affective words are perceived to be larger than negative or neutral words (Ode, Robinson, & Winters, in press). In all cases, the perceptual system appears to give greater salience to appetitive stimuli, a phenomenon that will be more systematically analyzed below.

Re-Conceptualizing Motivation-Perception Relations

Currently, one of the more intriguing theories regarding the utility of motivation-dependent changes in perception is one proposed by Aarts and his colleagues, who suggest that such perceptual influences operate in the service of non-conscious goal pursuit (Aarts et al., 2008). Within the context of this theory, the perceptual amplification of need-related stimuli may function to make such stimuli more attention grabbing and motivationally salient to the individual. Moreover, size could also be used as a way to gauge quantity, which could factor into value assessments and influence the attractiveness of an object.

An additional connection to non-conscious goal pursuit can be drawn from classic studies examining motivational systems. It had been proposed that the motivation to obtain a goal object increases as the distance to that object decreases (Lewin, 1935). This observation was scientifically confirmed in research showing that rats exerted more effort the closer they were to a reward (Brown, 1948; Kivetz, Urminsky, & Zheng, 2006; Liberman & Förster, 2008). The proposed reason for this relationship is that as the distance to the goal decreases, the likelihood that outside interference will impede goal attainment also decreases, thus making increased energy expenditure strategically adaptive. These ideas have become important components of several prominent theories of approach and

avoidance motivation (Brown, 1948; Hull, 1943; Liberman & Förster, 2008; Miller & Dollard, 1941).

In the context of non-conscious goal pursuit, the increased salience of goal objects may make them seem closer, which should function to make approach behavior more likely. Some implications of this idea have been demonstrated by Balcetis and Dunning (2010). Distances were self-reported as shorter if a desirable target location was involved. Another study required participants to throw a beanbag into a hole in a box in order to win a prize. It was found that participants tended to underthrow the beanbag when the prize had more value, suggesting that the target was perceived to be closer than it actually was.

It is easy to see how such considerations could be applied to the New Look research examining relations between motivation and apparent size. People approach desirable objects in the environment. As they do so, such objects get noticeably larger in the visual field. Further, as such objects loom larger perceptually, approach motivation should be increasingly vigorous. Thus, there are multiple considerations supporting a dynamic, bi-directional relationship between stimulus reward, approach motivation, and perceptions (e.g., larger size) that would occur to the extent that an individual actually moved toward the desired object.

A Dopamine Inspired Model of Approach Motivation and Perception

As noted earlier, one of the weaknesses of the New Look was the lack of a well-developed model regarding how and why need-size perception relations exist. In order to avoid repeating the mistakes of the past, a theoretical model must be introduced to help guide future research. In Figure 1, I present such a model which attempts to incorporate ideas from several areas of psychology.

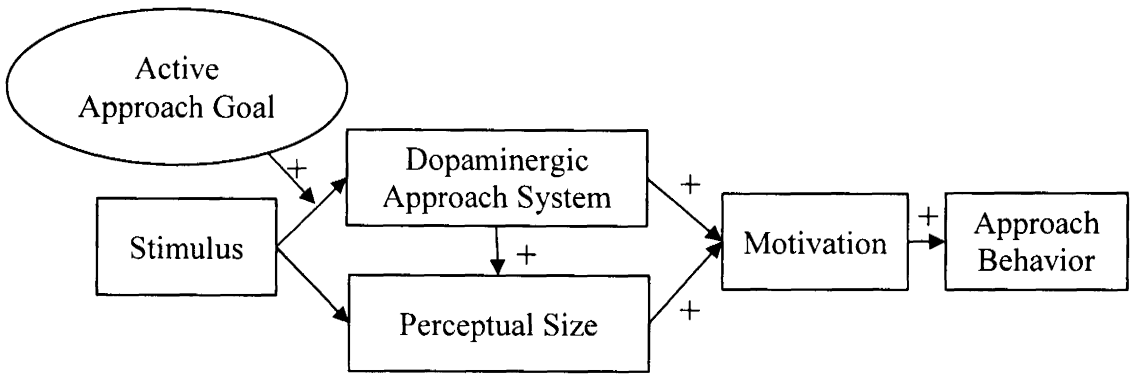

Figure 1. Proposed model of the relationship between approach stimuli, perceptual size, and approach behavior

There is significant support for the idea that stimuli associated with approach goals appear larger than stimuli that are neutral or associated with avoidance goals. This finding has been confirmed repeatedly in both classic (Beams, 1954; Bruner & Goodman, 1947; Lambert et al., 1949; Saugstad, 1966) and contemporary (Ode et al., in press; Veltkamp et al., 2008) psychological research. Additional evidence suggests that the perceptual size of objects can be altered by changing the motivational quality of the object (Lambert et al., 1949) and that manipulations of this type are effective even when they occur at a non-conscious level (Veltkamp et al., 2008). More recently, researchers have incorporated an additional assumption suggesting that perceptual enhancement serves to increase approach motivation, thereby making approach behaviors more likely (Aarts et al., 2008; Veltkamp et al., 2008).

In addition to the relationships outlined above, I have incorporated dopamine, a neurotransmitter known to be associated with approach motivation, into the model. It has been proposed that positive affect is positively correlated with dopamine release (Ashby, Isen, & Turken, 1999; Burgdorf & Panksepp, 2006) and that dopamine is fundamentally involved in motivational processes (Berridge & Aldridge, 2008; Berridge & Kringelbach, 2008; Depue & Collins, 1999; Schultz, 2002; Wise, 2002). Dopamine neurons show

increased activity following reward and exposure to stimuli associated with reward, presumably to indicate that reinforcement is to be expected and to facilitate learning reward signals (Schultz, 1998). Moreover, it has been shown that exposure to reward cues can result in greater dopamine release than obtaining the reward itself (Wise, 2002), suggesting that one of the functions of dopamine is to make environmental stimuli motivationally salient, drawing attention to them and assigning them a high priority for further processing (Schultz, 2002).

Current Studies

The model presented above makes a number of predictions, the examination of which would be an important step toward model verification. First, appetitive words should appear larger than neutral or unpleasant words. Second, priming individuals to think about their approach goals should increase the perceived size of appetitive words. Third, individuals high in measures purported to tap operations of the dopaminergic system should be particularly likely to overestimate the size of appetitive words. Fourth, individuals who overestimate the size of appetitive words to the greatest extent should exhibit higher levels of approach motivation and show greater reactivity to positive events in daily life. These predictions were tested in two separate studies.

STUDY 1

Study 1 primed approach goals by having some individuals, but not others, write about things that they want and desire in life. It was predicted that size overestimates for appetitive words would be larger among individuals in the approach motivation priming condition relative to the neutral priming condition, thus testing the active approach goal/perception link of the model. Additionally, because at its core the model represents a theory of how dopamine enhances reward perceptions, individual differences in variables previously associated with dopaminergic activity were hypothesized to exacerbate size overestimates for appetitive words.

Method

Participants

In Study 1, 89 participants were recruited from the North Dakota State University research pool. All participants were undergraduate students enrolled in psychology courses and received four points of course credit in exchange for their participation. Eight participants were dropped prior to analyses because English was not their native language or because they did not follow the instructions for the motivation manipulation task. Three participants were later identified as outliers based on extreme responses and were also dropped. Thus, the final sample consisted of 78 participants. Due to an unfortunate technical error, demographics were missing from 21 of the remaining participants. Of the participants with available demographic data, the average age was 19.8 years, 35 (51%) were female, and 52 (91%) reported being Caucasian in race.

Apparatus and General Procedures

All experimental procedures took place in a Hultz Hall computer lab equipped with six Windows-based computers, response boxes, and voice activated microphones. E-Prime software was used to administer the motivation manipulation and collect size estimation tendencies. Upon entering the lab, participants completed an informed consent form and then began the motivation manipulation. After finishing the manipulation, participants immediately began the size estimation task. Due to time constraints, participants were asked to complete several scales plausibly associated with dopamine activity (see below) at a later time by logging onto the North Dakota State University SONA system and completing the questionnaires online. Participants were given one additional point of credit for completing these questionnaires.

Motivation Manipulation

A writing task was used to manipulate the temporary motivational states of the participants in Study 1. In one condition, participants were instructed to write about something they were motivated to pursue in life. In the other condition, participants were instructed to write about plants, a topic that should not prime any particular motivations. Both writing cues were structured such that the wording was as similar as possible. Participants in the motivation condition saw these instructions:

> "What gives you pleasure? What excites you? What do you most enjoy doing? What do you look forward to in you daily life?"

Participants in the control condition saw these instructions:

> "What are some plants? What do these plants look like? Where do these plants grow? What happens to these plants on a daily basis?"

Participants were given five minutes to write their response. Condition assignment was counterbalanced across participants such that those with even subject numbers were

placed in one condition and those with odd subject numbers were placed in the other condition. In the final sample, 37 participants described plants while 41 participants described their approach goals. Writing responses were checked manually to ensure that participants complied with the experimental instructions. Typical responses for the motivation and control conditions are provided below.

Motivation:

> "Talking to friends. Doing anything outside, I love the outdoors. Seeing my boyfriend. Playing with our animals back home. Hanging out with friends is enjoyable. Doing random things, being impulsive. Going new places without knowing anyone there, being forced to learn about new people and what their life is like. I like spending time with my family. I enjoy seeing my brother and his wife when they come home. I like to play softball with my friends. I like to go on trips where you don't really know where you're going, we just start driving and see where we end up. I enjoy a lot of things in life."

Control:

> "There are plants in all sorts of varieties. When I think of plants I picture green things growing out of the ground, however; plants can be many different colors and don't necessarily have to be growing out of the ground. I don't know of that many different types of plants, I mainly just know about flowers and trees in general. I know that plants depend on oxygen in the air and in the soil in order to grow, and many plants carry out a process known as photosynthesis which takes light and turns it into energy which is needed by the plant to grow."

Perceptual Task

When participants finished writing, they began the perceptual task. In this task, participants were shown a word presented toward the bottom 1/3 of the computer screen in all capital letters. Sixty words were chosen for this task based on their motivational relevance: 1/3 were pleasant/appetitive, 1/3 were unpleasant/aversive, and 1/3 were neutral (see Appendix A for the complete list of words). Words were selected at random on a trial-by-trial basis and were presented in a 10, 12, 14, 18, 20, or 22 point font size. Each word

was used twice resulting in a total of 120 trials. Separate font size lists were created for each word type from which the computer chose at random for any particular trial. This step ensured that font sizes were evenly distributed among word types.

To ensure that participants processed the meaning of the words they were being exposed to, they were instructed to categorize the word as "good" "bad" or "neutral" by speaking into a voice keyed microphone prior to making any size estimates. After the computer detected a verbal response, the letter "Z" appeared on the top 1/3 of the screen in 16 point font. Participants then used the up and down arrows to adjust the font size of the "Z" so that it matched the perceived font size of the word. Pressing the up arrow made the "Z" larger, and pressing the down arrow made the "Z" smaller. When participants were satisfied that the size of the "Z" matched the font size of the word, they were instructed to hit the enter key. Participants were told in the task instructions that the size of the letters in the word would always be different than the size of the comparison "Z", such that they would have to make an adjustment on every trial. A 1500 ms error message was presented reminding participants of the task procedures if they took more than 6 seconds to enter their response or if they failed to make any adjustments to the "Z".

All task stimuli were presented in the Courier-New font style and all letters were capitalized. This ensured that all letters of a given font size would be the same height and take up approximately the same width of space on the screen. The letter "Z" was chosen as a reference letter because it maximizes the vertical and horizontal dimensions relative to some other letters.

Self-Reported Personality Questionnaires

As noted earlier, an important step toward model verification would be to demonstrate that the perceived size of appetitive stimuli relates to dopamine functioning. Though there is substantial evidence linking dopaminergic systems to approach tendencies, the functioning of such systems is notoriously difficult to assess and manipulate in non-invasive ways (Depue & Collins, 1999; Depue, Luciana, Arbisi, Collins, & Leon, 1994). Given these difficulties, it would seem wise to assess relations between perceived size and variables previously associated with more reactive dopaminergic systems in animal models and bio-genetic studies. Three of these variables (described below) were assessed in Study 1. All scale items and their scoring keys can be found in Appendix B.

Novelty Seeking: Rats that have been administered dopamine agonists or that have been bred to have a highly reactive dopaminergic system show greater exploratory behaviors relative to normal rats. The opposite is true for rats that have had been administered dopamine antagonists or have had their dopaminergic system impaired in some way (Wise, 2002, 2004). Similarly, humans that are predisposed to have more reactive dopaminergic systems in allele studies have been shown to self-report higher levels of novelty seeking and a greater openness to change and variety (Ebstein et al., 1996; Ebstein & Belmaker, 1997; Lusher, Chandler, & Ball, 2001). For such reasons, participants filled out a novelty seeking assessment taken from the International Personality Item Pool (IPIP: Goldberg et al., 2006). This 10-item scale consists of both positively and negatively keyed items, and is modeled after Cloninger's Temperament and Character Inventory (Cloninger, 1994).

Sensitivity to Reinforcement: Animal models have also shown that increased reactivity of dopaminergic systems results in increased sensitivity to reward and higher levels of synaptic dopamine result in greater instrumental conditioning using rewards (Berridge, 2007; Berridge & T. E. Robinson, 1998; Wise, 2002, 2004). In humans, individuals who are genetically predisposed to release more dopamine have been shown to be particularly sensitive to rewarding stimuli (Forbes et al., 2009). To capture the potential relations between reward sensitivity and dopamine reactivity, participants completed the Sensitivity to Reinforcement of Addictive and other Primary Rewards scale (SNAP-R: Goldstein et al., 2010). This scale contains subscales specifically designed to assess reward sensitivity associated with food, sex, and drugs.

Achievement Seeking: Finally, individuals who have high dopamine reactivity are likely to be quite a bit higher in achievement motivation, particularly in terms of level of aspiration and persistence (Tomer, Goldstein, Wang, Wong, & Volkow, 2008). Accordingly, participants completed an IPIP achievement seeking scale (Goldberg et al., 2006). The scale is based on Tellegen's well validated Multidimensional Personality Questionnaire (Tellegen, 1982), and consists of 10 positively and negatively scored items.

Predictions

Several predictions were made for Study 1. First, people were hypothesized to overestimate the size of appetitive words relative to neutral or aversive words. Second, the motivation manipulation should increase the magnitude with which appetitive stimuli were overestimated in size. It was also predicted that this relationship would be moderated by each of the dopaminergic reactivity indicators.

Results

Trials in which participants failed to adjust the "Z" or took too long to make their decisions were thrown out (less than 3% of all trials). Bias scores were then calculated for each word by subtracting the font size of the word from the size of the letter chosen by the participant. To reduce the influence of outliers, bias scores that fell greater than 2.5 *SD*s from the mean were replaced with the cutoff values. Average bias scores were then quantified for each word type for each participant. Personality questionnaires were scored according to their relevant scoring instructions. Five participants were missing questionnaire data but were retained for normative analyses. Means, standard deviations, and alphas (when applicable) are listed in Table 1.

Table 1. *Descriptive Statistics for Study 1*

	Control Condition (n = 37)		Motivation Condition (n = 41)	
Measure	*M*	*SD*	*M*	*SD*
Task Accuracy	97.25%	1.80%	96.89%	2.02%
Average Bias	1.96	1.07	1.87	1.06
Aversive Word Bias	1.95	1.19	1.80	1.11
Neutral Word Bias	1.74	1.05	1.76	1.05
Appetitive Word Bias	2.17	1.96	2.04	1.08
Measure (n = 73)	*M*	*SD*	Alpha	Scale
Novelty Seeking	3.67	0.59	0.83	1-5
STRAP-R Food	3.37	0.77	0.68	1-5
STRAP-R Sex	3.54	1.15	0.92	1-5
STRAP-R Drugs	2.38	1.06	0.92	1-5
STRAP-R Average	3.10	0.85	0.92	1-5
Achievement Seeking	3.76	0.65	0.88	1-5

Initial tests found that mean bias scores were significantly different from zero for both the control ($t(36) = 11.13, p < .0001$) and motivation ($t(40) = 11.32, p < .0001$) conditions. Subsequently, General Linear Model (GLM) analyses were conducted to assess the interactive relationship between word type and manipulation condition as well as the

potential moderating influence of the dopamine-related individual difference variables. Results of these analyses are presented in Table 2.

Table 2. *Results for Word Type x Condition x Individual Difference Interactions*

	df	*F*	*Eta Squared*
Condition	1, 76	0.14	0.00
x Novelty Seeking	1, 69	0.51	0.01
x STRAP-R Food	1, 69	0.35	0.00
x STRAP-R Sex	1, 69	2.50	0.03
x STRAP-R Drugs	1, 69	1.19	0.02
x STRAP-R Average	1, 69	1.67	0.02
x Achievement Seeking	1, 69	0.25	0.00
Condition x Word Type	2, 152	1.90	0.02
x Novelty Seeking	2, 138	0.79	0.01
x STRAP-R Food	2, 138	2.80†	0.03
x STRAP-R Sex	2, 138	0.85	0.01
x STRAP-R Drugs	2, 138	2.67†	0.03
x STRAP-R Average	2, 138	1.98	0.02
x Achievement Seeking	2, 138	5.65*	0.06

†$p < .10$, *$p < .01$

Ignoring word type, the main effect for condition was not significant. In addition, there were no condition by individual difference interactions. It should be mentioned that such effects were not predicted as they collapse across the word type variable. I had hypothesized a condition by word type interaction such that individuals in the motivation condition should be particularly likely to overestimate the size of appetitive words. Unfortunately, this interaction did not occur. On the other hand, it is possible that the condition manipulation might interact with individual differences to predict size overestimations for appetitive words. One such three-way interaction was significant. To determine the nature of this interaction, means were estimated for individuals low (-1 *SD*) vs. high (+1 *SD*) in achievement seeking. These means are graphed in Figure 2. Follow up analyses were conducted for each condition considered separately.

A word type by achievement seeking interaction was found in the control condition ($F(2, 64) = 4.86, p < .05$), but not the motivation condition ($F(2, 74) = 1.27, p > .25$).

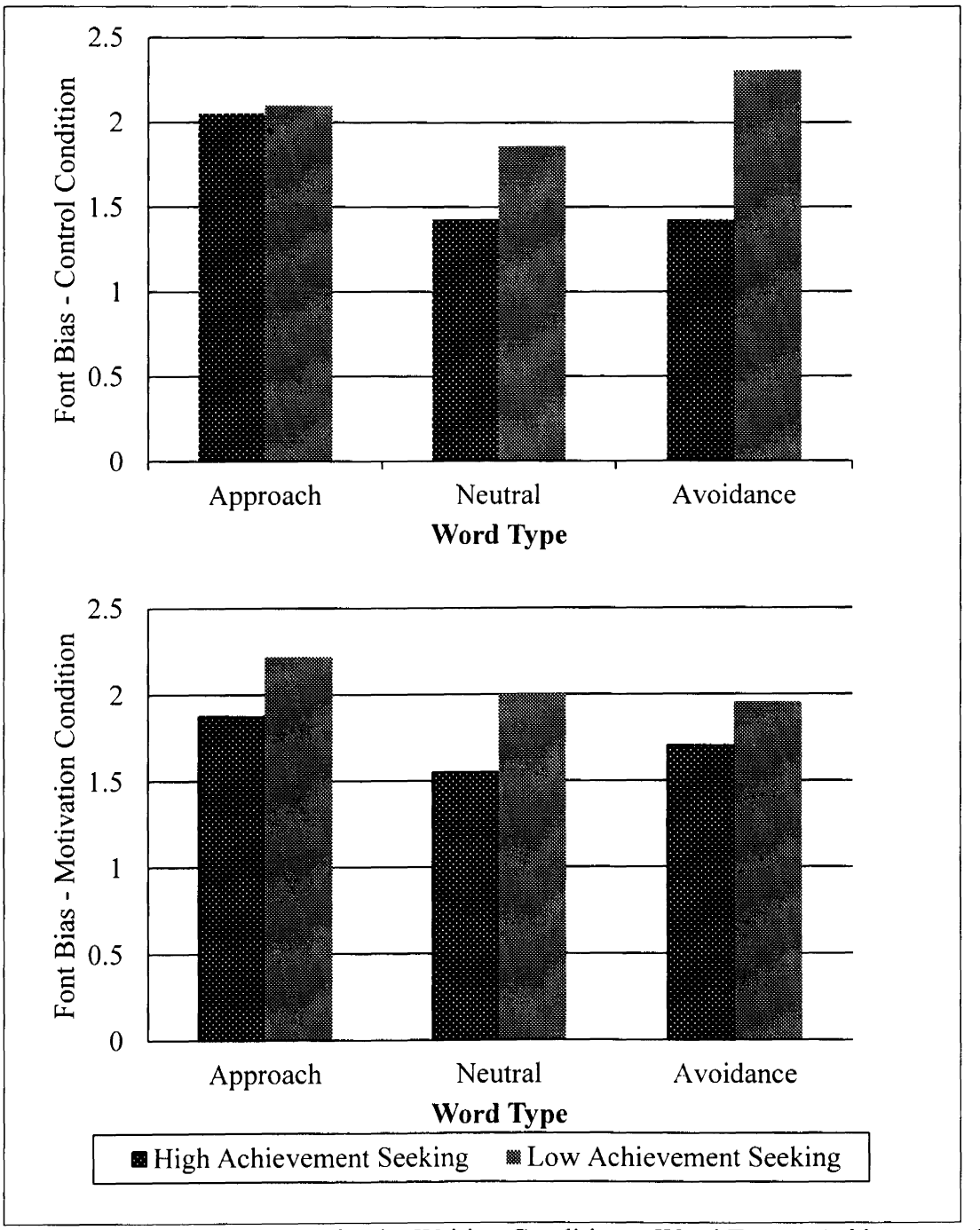

Figure 2. Estimated means for the Writing Condition x Word Type x Achievement Seeking interaction

For the remaining analyses, it was deemed useful to collapse across the condition variable, which was not particularly influential. A GLM without any individual difference

variable was first run. There was a robust main effect for word type in this analysis (see Table 3 and Figure 3). Follow-up pairwise comparisons found that bias scores for each word type were significantly different from one another (appetitive vs. neutral ($F(1,77) = 48.66, p < .001$, *Eta Squared* = 0.39); appetitive vs. aversive ($F(1, 77) = 20.60, p < .001$, *Eta Squared* = 0.21); aversive vs. neutral ($F(1, 77) = 6.54, p < .05$, *Eta Squared* =0.08)).

Table 3. *Results for Word Type x Dopamine Interactions, Study 1*

	DF	*f*	*Eta Squared*
Word Type	2, 154	25.99**	0.75
x Novelty Seeking	2, 142	3.69*	0.04
x STRAP-R Food	2, 142	0.38	0.00
x STRAP-R Sex	2, 142	1.79	0.02
x STRAP-R Drugs	2, 142	1.05	0.01
x STRAP-R Average	2, 142	0.77	0.01
x Achievement Seeking	2, 142	0.62	0.01

*$p < .05$, **$p < .001$

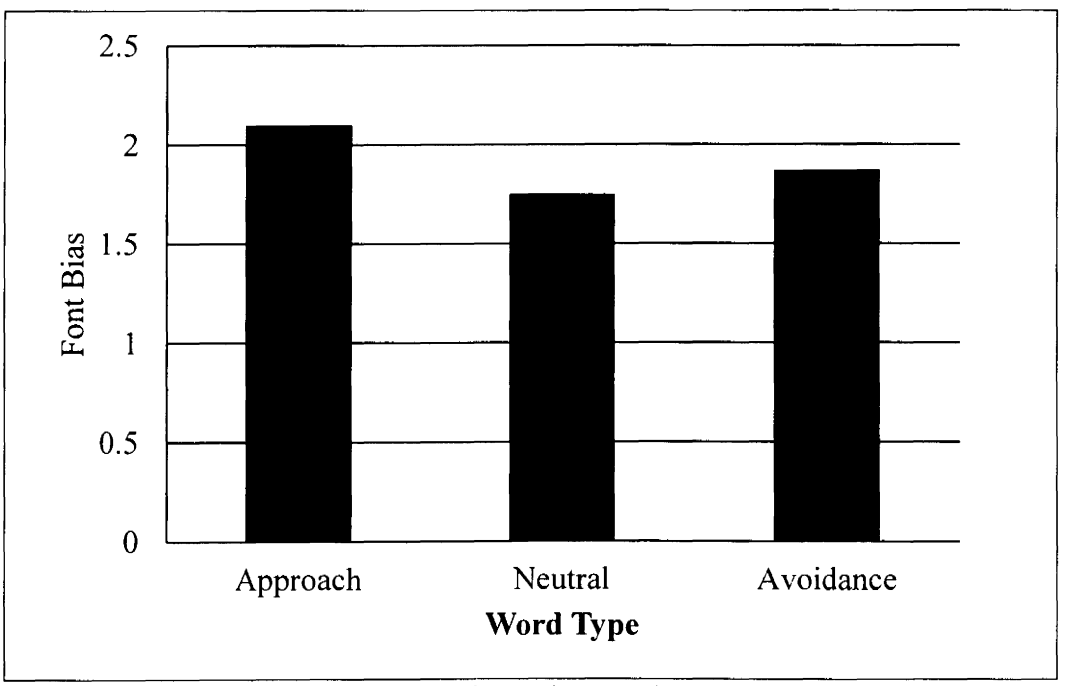

Figure 3. Font Bias as a function of Word Type, Study 1

Next, I examined whether the individual difference variables moderated the influence of word type on size estimations. As shown in Table 3, there was a significant

Novelty Seeking by word type interaction. To help interpret the significant interaction, means were estimated for individuals low (-1 *SD*) and high (+1 *SD*) in Novelty Seeking. These estimated means are presented in Figure 4. As shown there, individuals high in novelty seeking exhibited the hypothesized appetitive word enhancement pattern. By contrast, individuals low in Novelty Seeking exhibited a pattern in which motivation words of either valence were enhanced relative to neutral words.

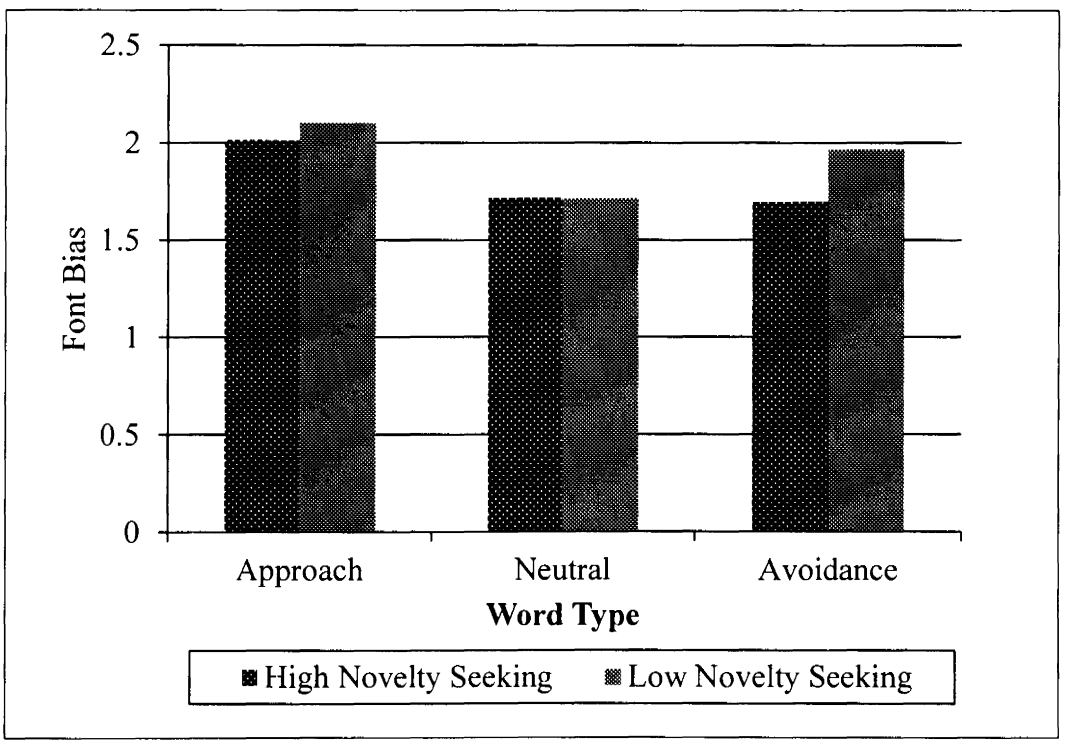

Figure 4. Estimated means for the Word Type x Novelty Seeking interaction

Discussion

Ode et al. (in press) found that appetitive words were seen to be larger than aversive or neutral words, consistent with a behavioral approach dynamic. Importantly, Study 1 replicated this pattern using a quite different paradigm in which size estimates were based on participant adjustments rather than multiple choice responding. Unexpectedly, aversive stimuli were seen to be larger than neutral stimuli. To the extent that this pattern replicates, there appear to be two affective phenomena involved. It may be

that aversive words appear larger because they have some motivational relevance, and perceiving them as larger could function to alert the individual to potentially dangerous stimuli. On top of that, however, the perceptual system seems to favor appetitive stimuli. It is possible that future studies of the present type would choose to contrast size estimates for appetitive vs. aversive stimuli, thus controlling for the general enhancement of any motivation-related stimulus.

It was predicted that priming approach motivation would result in enhanced size estimates for appetitive words. This did not occur. Though positive results would have represented a major step toward model verification, the lack of significant findings in this regard should not be taken as evidence that the model is invalid. It may be that there was not a close enough relationship between the approach goals that were activated by the manipulation and the stimuli being judged. It is possible that a more targeted manipulation and set of stimuli would support the basic hypothesis. For example, it may be beneficial to have participants write about how much they enjoy socializing with others before having them estimate the size of neutral words and words associated with affiliation and friendship. In other words, it may have been that the manipulation used was too general to capture the manner in which approach motivation more typically works (i.e., in an incentive specific manner).

According to the model, the effect of word type should be amplified among dopamine reactors, which was defined in three ways (i.e., novelty seeking, sensitivity to reinforcement, and achievement seeking). Only one of the three individual difference by word type interactions was significant. Furthermore, the one that was found to be significant - involving novelty seeking - did not exhibit the expected pattern. The greatest

difference occurred for aversive words, whereas it should have occurred for appetitive words. On the other hand, the appetitive minus aversive comparison clearly favors high levels of novelty seeking, seemingly consistent with the original hypothesis. The reliability of this interaction will be examined in Study 2.

There was one three-way interaction involving achievement seeking. One might expect high achievement individuals to show greater enhancement of appetitive words relative to other words. Note that this pattern was evident in the control writing condition, presumably the condition better tracking habitual tendencies. By contrast, it appears that the motivation writing condition eliminated this pattern. The reliability of the former pattern will be examined in Study 2, in which no manipulation was used.

STUDY 2

According to the model presented, individual differences in the tendency to overestimate the size of appetitive words (relative to neutral words) may tell us something important about the approach system of the individual. The most interesting way of examining this idea would involve linking word perceptions to motivations and reactions to events in daily life.

Study 2 takes such an approach. It was predicted that individuals who tend to perceive appetitive words to be larger than neutral words would exhibit general tendencies conceptualized in terms of approach motivation. First, they may have appetitive thoughts and desires more often. Second, they may display greater persistence in pursing their typical goals. Third, they may engage in more impulsive behaviors, which are thought to reflect especially high levels of approach motivation.

In addition to such "main effects", Study 2 also examines reactions to positive events in daily life as positive events should trigger the approach system. Three such reactions were examined. First, I examined the extent to which positive events triggered positive affect. Second, I examined the extent to which positive events energized people to overcome obstacles to goal pursuit. Third, I examined the extent to which positive events led to achievement motivation, as achievement motivation has been linked to dopaminergic activity in previous research (Tomer et al., 2008).

Method

Participants

In Study 2, 125 participants were recruited from the North Dakota State University research pool. Of the original 125, 14 were eventually dropped - nine were non-native

English speakers and five were persistent outliers on the perceptual task. Thus the final sample consisted of 111 undergraduates. Fifty-five (49.55%) were female, 96 (86.5%) were Caucasian, and the average age was 19.6 years. Participants were awarded four points of class credit for participating in the laboratory portion of this study.

Study 2 also included a 14 day daily protocol. Participants could earn a maximum of 12 points of class credit or $20.00 cash for completing the daily portion of the study. However, to encourage compliance, participant compensation was reduced by one point of class credit or $2.00 for every survey that was missed. If participants missed more than four surveys, they were dropped from the daily potion of the study. In all, 21 participants failed to provide sufficient daily data and were not used in the daily analyses. The remaining 90 participants filled out an average of 11.68 surveys, yielding a total of 1165 daily reports.

Apparatus and General Procedures

The laboratory session for Study 2 was conducted in the same Hultz Hall computer lab that was used for Study 1. As before, this lab consisted of six Windows-based computers with response boxes and voice activated microphones. E-Prime software was used to administer the perceptual task, the individual difference measures assessed in Study 1 were collected using MediaLab software, and daily surveys were administered via the North Dakota State University SONA systems website. Once informed consent was obtained, participants began the perceptual task, followed by the personality questionnaires. When participants had completed the lab session, they were given instructions for the daily portion of the study.

Participants were instructed to complete the surveys between 8:00 pm and when they went to bed for 14 consecutive nights. Such timing allowed for a relatively accurate estimate of the occurrences of the day. To ensure that participants did not complete the surveys too early or too late, they were posted each evening at around 5:00 pm and taken down promptly the following morning, generally between 8:00 am and 10:00 am. Participants were sent daily e-mails reminding them to complete each survey. Similar procedures have been used by the principal investigator in the past and have proven to be an effective means of gathering daily data (Hilmert, Ode, Zielke, & M. D. Robinson, 2010; Ode, Hilmert, Zielke, & M. D. Robinson, 2010).

Perceptual Task

The paradigm used in Study 2 was similar to the paradigm used in Study 1, except that there was no motivation manipulation and the size estimations were made in a slightly different manner. The same 60 words used in Study 1 were also used in Study 2, and each word was presented twice resulting in a total of 120 trials. Words were presented in 10, 12, 14, 16, 18, 20, or 22 point font such that each font size was used equally often across the three word type conditions.

At the beginning of the task, participants were presented with a list of 17 reference letters located on the left side of the computer screen. The reference "Z"s ranged in size from 8 to 24 point font in increments of one and were arranged vertically in ascending or descending order counterbalanced across participants. Note that the smallest and largest "Z"s extended beyond the actual sizes of the words such that even the largest word could be overestimated in its font size. These reference letters remained on the screen for the duration of the task.

On each trial, a word was presented on the right 1/3 of the computer screen, centered vertically. Participants categorized the word as good, bad, or neutral in valence by speaking into the computer microphone. When the computer registered a verbal response, the mouse cursor appeared and participants were given 6 seconds to select the "Z" that was the same size as the letters in the word. If they failed to respond within the 6 second time window, they received a 1500 ms error message reminding them of the task procedures. To help illustrate what participants saw, a screen shot representing a single trial in the experiment is provided in Figure 5.

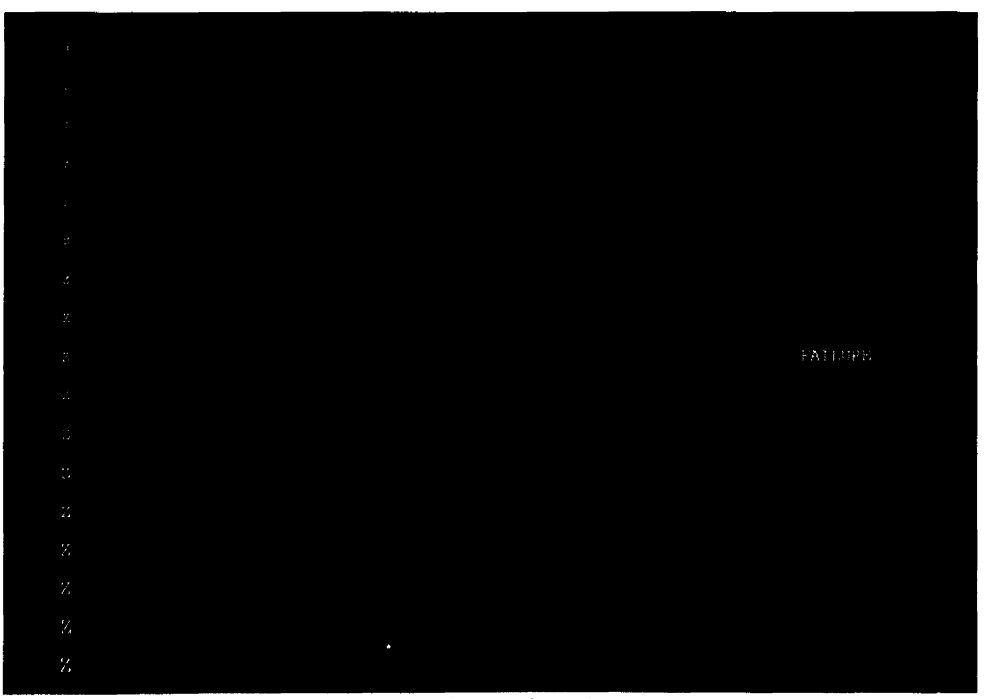

Figure 5. Screen shot for Study 2 size estimation task

Self-Reported Personality Questionnaires

The same personality questionnaires used in Study 1 were also used in Study 2 (i.e., Novelty Seeking, Sensitivity to Reinforcement, and Achievement Seeking). A full list of items and their scoring can be found in Appendix B.

Daily Survey

Of greater interest than the personality questionnaires were the daily outcomes. Main effects for appetitive word overestimation were expected for appetitive thoughts, persistence, and impulsive behavior. Stronger reactions to daily positive events were hypothesized in relation to positive affect, motivation to overcome obstacles, and achievement motivation. All items and their scoring are listed in Appendix C.

Appetitive Thoughts: As noted earlier, individual differences in approach motivation should predict the degree to which a given individual has appetitive thoughts on a daily basis. Therefore, the daily questionnaire included two items assessing the degree to which appetite thoughts characterized their day on a 1 (strongly disagree) to 5 (strongly agree) scale.

Goal Persistence: Approach motivated individuals should also be more persistent in their goal pursuit. Three questions were included in the questionnaire to assess the degree to which participants persisted in goal pursuit on a 1 to 5 scale.

Impulsive Behaviors: Impulsive behaviors should be more prevalent among individuals who are sensitive to appetitive stimuli. Accordingly, the daily questionnaire included three items assessing the number of times an individual engaged in impulsive behaviors on a given day on a scale of 0 (not a single time) to 3 (more than two times).

Positive Events: Individual differences in approach motivation should predict the extent to which individuals react to positive events. Therefore, the daily questionnaire included two items intended to assess whether or not positive events were a part of their day on a 1 (not at all true today) to 4 (very much true today) scale.

Positive Affect: I intended to assess the degree to which affective bias scores could predict relations between positive events and positive affect. As such, participants reported the degree to which they felt two positive emotions on a 1 (not at all) to 5 (extremely) scale.

Motivation to Overcome Obstacles: In addition to increasing positive affect, positive events should also trigger a drive to overcome obstacles among individuals who overestimate the size of appetitive words. Participants answered two questions regarding the degree to which they were motivated to overcome daily obstacles on a 1 (not at all true today) to 4 (very much true today) scale.

Achievement Motivation: Finally, positive events should also increase achievement motivation. Thus, the questionnaire included two items assessing the degree to which participants were achievement motivated on a 1 (not at all true today) to 4 (very much true today) scale.

Results

Initial Results

Scoring procedures for the perceptual task were similar to those used in Study 1. Trials in which participants took too long to make their decisions were thrown out (less than 2% of all trials) and bias scores were calculated by subtracting the font size of the word from the size of the letter chosen by the participant. Bias scores greater than 2.5 *SD*s from the mean were replaced by the cutoff values and average bias scores were then quantified for each word type for each participant. Self-report measures were scored according to their relevant scoring keys. Means, standard deviations, and alphas (when applicable) are listed in Table 4.

Table 4. *Descriptive Statistics for Study 2*

Measure (n = 111)	*M*	*SD*		
Task Accuracy	98.84%	1.67%		
Average Bias	1.19	0.94		
Aversive Word Bias	1.16	1.00		
Neutral Word Bias	0.95	0.99		
Appetitive Word Bias	1.47	0.99		
Measure (n = 111)	*M*	*SD*	Alpha	Scale
Novelty Seeking	3.66	0.63	0.84	1-5
STRAP-R Food	3.40	0.91	0.76	1-5
STRAP-R Sex	3.18	1.10	0.87	1-5
STRAP-R Drugs	2.21	1.02	0.91	1-5
STRAP-R Average	2.90	0.78	0.89	1-5
Achievement Seeking	3.62	0.66	0.86	1-5
Daily Variable (n = 1165)	*M*	*SD*	Alpha	Scale
Appetitive Thoughts	3.50	1.04	0.71	1-5
Goal Persistence	3.38	0.93	0.67	1-5
Impulsive Behavior	0.78	0.66	0.66	0-3
Positive Events	2.62	0.90	0.85	1-4
Positive Affect	3.01	1.13	0.85	1-5
Overcome Obstacles	2.62	0.89	0.80	1-4
Achievement Motivation	2.90	0.89	0.86	1-4

Normatively, average bias scores were found to be significantly different from 0, indicating that on average all words were perceived to be larger than they actually were ($t(110) = 13.43, p < .01$). I next sought to determine whether such size overestimations varied by word type in a GLM analysis. As shown in Table 5, there was a robust word type main effect. Means for the main effect are graphed in Figure 6. As in Study 1, follow up pair wise comparisons revealed that appetitive words were perceived to be larger than neutral words ($F(1, 110) = 95.48, p < .001$) and aversive words ($F(1, 110) = 24.03, p < .001$), and that aversive words were perceived to be larger than neutral words ($F(1, 110) = 20.00, p < .001$).

The results involving the purported dopamine-related variables were somewhat disappointing in Study 1. This was even more so the case in Study 2. As shown in Table 5, none of the variables interacted with word type to predict size overestimations.

Table 5. *Results for Word Type x Dopamine Interactions, Study 2*

	df	*F*	*Eta Squared*
Word Type	2, 220	45.45*	0.29
x Novelty Seeking	2, 218	1.64	0.01
x STRAP-R Food	2, 218	0.11	0.00
x STRAP-R Sex	2, 218	0.58	0.00
x STRAP-R Drugs	2, 218	0.89	0.01
x STRAP-R Average	2, 218	0.80	0.01
x Achievement Seeking	2, 218	0.20	0.00

*$p < .0001$

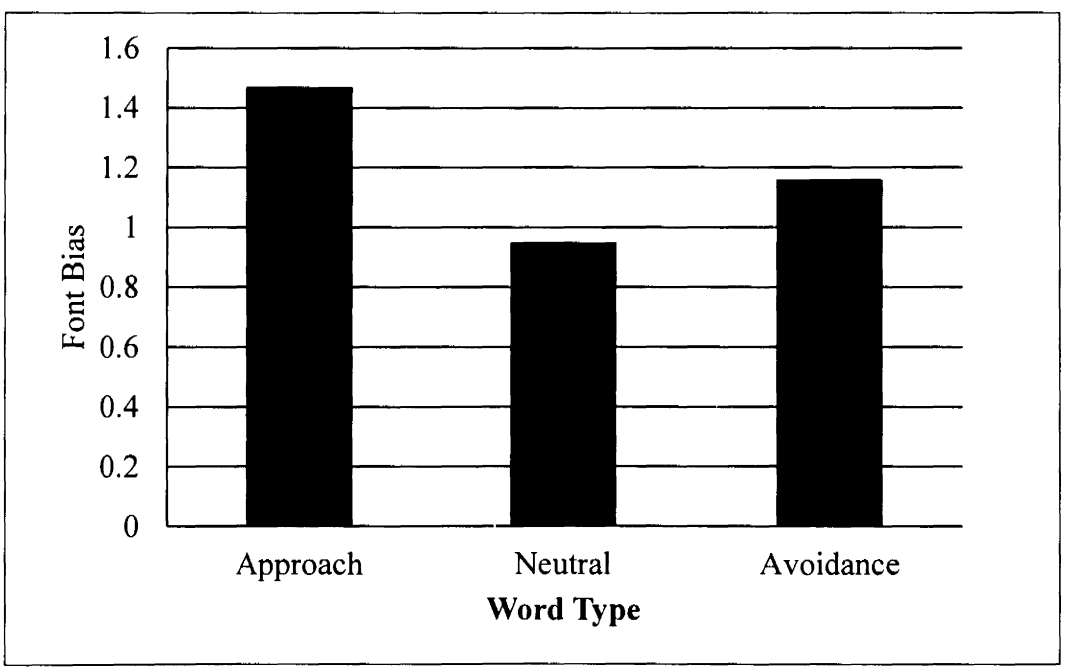

Figure 6. Font Bias as a function of Word Type, Study 2

Results Involving Daily Outcomes

Following these initial analyses, predictions involving the daily variables were tested. Given the structure of the dataset, in which daily variables were nested within subjects, Multi-level Linear Modeling (MLM) techniques were used. Such techniques are ideal in these situations as they adjust for missing data and problems associated with co-linearity among variables (Nezlek, 2007; Tabachnick & Fidell, 2006). All MLM analyses were conducted using SAS PROC MIXED procedures (Singer, 1998).

There was a general tendency to overestimate the size of all words. However, I sought to quantify size overestimations particular to the appetitive word condition. Therefore, a difference score was created by subtracting size estimations for neutral words from size estimations for appetitive words. There were three "main effect" predictions. Appetitive enhancers were hypothesized to have more appetitive thoughts, to display greater persistence, and to engage in more impulsive behaviors. MLMs testing these predictions failed to support them (see Table 6, *ps* > .20). Thus, difference scores in the tendency to overestimate appetitive words vs. neutral words do not appear to predict daily outcomes in the absence of some precipitating event.

Table 6. *Fixed Effects for Initial MLM Analyses*

Variable	Parameter Estimate	Standard Error	*t*-value (*DF* = 88)
Appetitive Thoughts	0.07	0.08	0.88
Goal Persistence	-0.02	0.06	-0.25
Impulsive Behaviors	0.06	0.05	1.16

Following these initial comparisons, the predicted cross-level interactions were investigated. Such analyses make it possible to determine the degree to which individual difference variables influence relations between daily variables (Nezlek, 2007; Tabachnick & Fidell, 2006). Consistent with literature recommendations, appetitive-neutral difference scores were z-scored prior to analyses and the positive event daily variable was person centered such that the average level of the variable for a given individual was zero (Enders & Tofighi, 2007). As a consequence, results involving positive events are always with respect to the person's typical day. Because the mean of the outcome variables (the intercept) and the relationships between the two daily variables (the slope) were expected to vary between individuals, intercepts and slopes were treated as random effects in all subsequent MLM analyses (Nezlek, 2007; Tabachnick & Fidell, 2006). Results of these

analyses are presented in Table 7. I had hypothesized that all three outcomes would systematically increase on days associated with more positive events and this was the case. Such slopes, on the other hand, were hypothesized to be steeper for appetitive enhancers. As shown in Table 7, in terms of the positive events x difference score term, two of the three interactions were significant. Note that "main effects" were again non-significant.

Table 7. *Fixed Effects For Cross Level Interactions*

	Parameter Estimate	Standard Error	*t*-value
Dependent Variable: Positive Affect			
Intercept	3.01	0.08	38.46*
Daily Positive Events	0.63	0.04	15.86*
Positive-Neutral Bias Difference Score	-0.03	0.08	-0.33
Positive Events x Difference Score	-0.01	0.04	-0.37
Dependent Variable: Motivation to Overcome Obstacles			
Intercept	2.64	0.06	43.69*
Daily Positive Events	0.21	0.04	5.16*
Positive-Neutral Bias Difference Score	-.01	-0.06	-0.09
Positive Events x Difference Score	0.08	0.04	2.00*
Dependent Variable: Achievement Motivation			
Intercept	2.91	0.06	50.95*
Daily Positive Events	0.26	0.04	6.40*
Positive-Neutral Bias Difference Score	0.00	0.06	0.06
Positive Events x Difference Score	0.09	0.04	2.26*

* $p < .05$

To aid in interpreting the significant cross-level interactions, means were estimated for days high (+1 *SD*) and low (-1 *SD*) in positive events for individuals with high (+1 *SD*) and low (-1 *SD*) affective bias difference scores. These graphs are presented in Figure 7. As shown there, individuals who were biased to perceive appetitive words as larger than neutral words experienced increased motivation to overcome obstacles and increased motivation to achieve their goals on days associated with more positive events. Thus, individuals who overestimate the size of appetitive words also gain motivational energy from positive events in daily life.

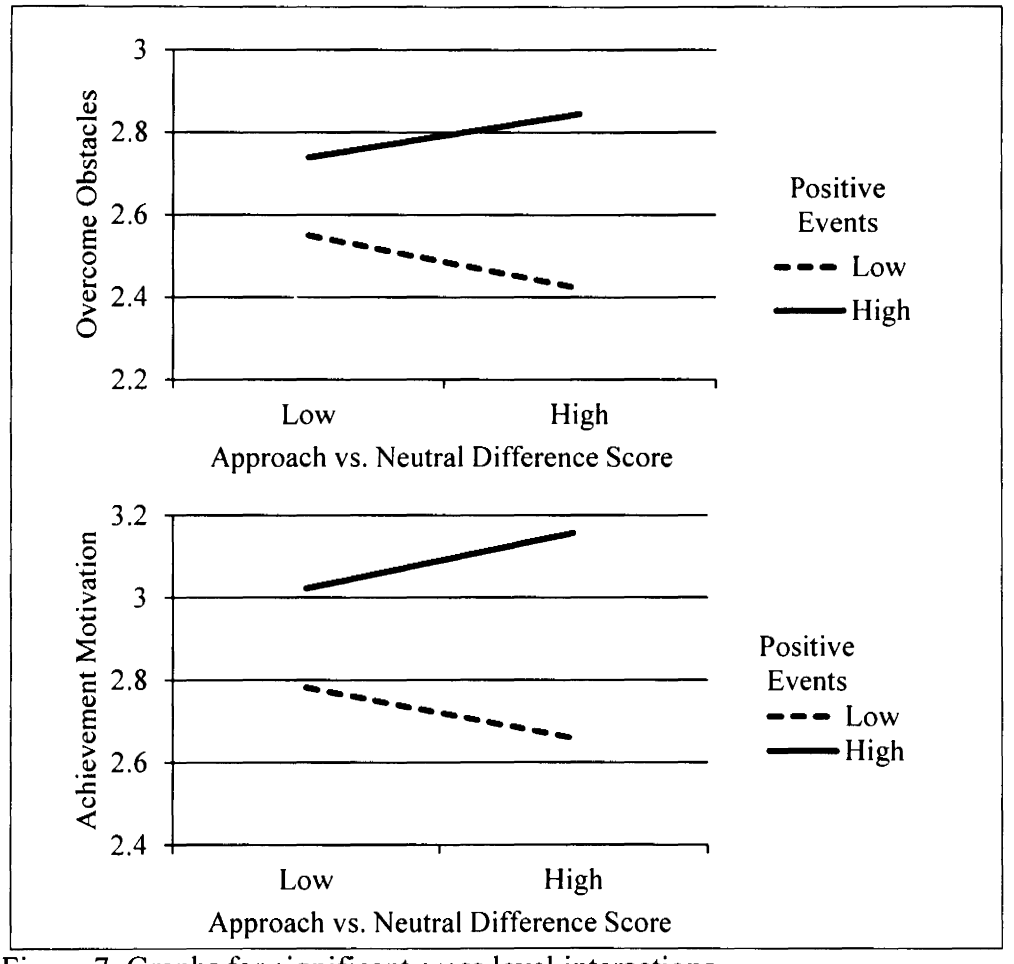

Figure 7. Graphs for significant cross level interactions

Follow-up simple slopes analyses are relatively consistent with this interpretation (Aiken & West, 1991; Fleeson, 2007; Nezlek, 2007). Though both simple slopes were significant, the relation between positive events and motivation to overcome obstacles was stronger at high ($t(1073) = 5.00, p < .001$) relative to low ($t(1073) = 2.30, p < .05$) levels of the difference score,. Similarly, the relation between positive events and achievement motivation was stronger at high ($t(1073) = 6.04, p < .001$) relative to low ($t(1073) = 3.02, p < .01$) levels of the difference score, though both simple slopes were again significant.

Discussion

As predicted, the normative findings from Study 2 show that appetitive stimuli are perceived to be larger that stimuli that are neutral or aversive in nature. This is consistent

with previous findings (Ode et al., in press) and the model outlined in the introduction. Also, the finding from Study 1, in which aversive words were perceived to be larger than neutral words, was replicated in Study 2. Thus, there appear to be two motivational influences on size perceptions, one common to appetitive and aversive words and one unique to appetitive words.

Follow-up analyses in which dopaminergic variables were included as moderators of the motivation-size relationship were found to be non-significant. This was not predicted by the model, but is nonetheless generally consistent with what was found in Study 1, with the exception of novelty seeking. Potential reasons for such null results are explored in the General Discussion.

Independent of daily events, it was not the case that appetitive enhancers had more appetitive thoughts, exhibited greater goal persistence, or engaged in more impulsive behaviors. Main effects are notoriously difficult to obtain in MLMs, likely because daily life involves an ebb and flow of events and their reactions. In addition, the cognitive variable assesses reactivity to a particular class of stimuli (appetitive stimuli) and should therefore predict *reactions* to positive events and occurrences.

Indeed, other analyses established that positive events energized motivation (to overcome obstacles and to achieve) among appetitive enhancers. The expected interaction involving positive affect did not occur. Thus, the word measure seems to assess motivational tendencies to a greater extent than emotional tendencies. This disassociation is consistent with my model, which focuses on motivational priming.

GENERAL DISCUSSION

The results of Studies 1 and 2 provide, at best, mixed support for the proposed model. While the analyses examining the influence of word type on size perception were consistent with the model and previous research, most of the interactions involving word type and the individual difference variables were not significant. The one instance in which significant results were obtained was not replicated across studies. Similarly, manipulating motivational state did not influence size perception except when analyzed in the context of achievement seeking, and only two of the MLM analyses were significant. As a result, it can be concluded that either the explanatory model constructed in the introduction does not adequately capture the causes and consequences of motivation-size relations or the studies presented above did not tap the constructs in the manner intended.

Problematic Results

Though the model predicted that manipulating motivational state would influence the perceived size of appetitive stimuli, the manipulation used in this study did not significantly influence size perception in the absence of any individual difference moderators. It was assumed that general activation of the approach system should put participants in an active motivational state and thus cause all appetitive stimuli to appear larger. In hindsight, it may be that this approach was too broad; instead, there likely needs to be a tighter relationship between how motivation is activated and the stimuli used in the size estimation task. In Study 1, participants were asked to write about what they found to be pleasurable in very broad terms, and there was no guarantee that the types of items or activities identified by the participants were encapsulated by the words they were asked to judge. As noted earlier, it may be beneficial to induce a very specific motivational state,

and then ask participants to estimate the size of stimuli particular to that motivational state. It also may have been that the normative tendency for individuals to perceive motivational words to be larger is strong enough to override the motivation manipulation. Perhaps weaker or more ambiguous stimuli would prove more sensitive to states and traits related to approach motivation.

Also, there were only two significant interactions involving dopamine variables. In one, novelty seeking interacted with word type to predict size estimates. Here it was found that individuals high in novelty seeking were more influenced by word type than individuals low in novelty seeking, though this difference was primarily driven by the aversive word condition. Such a pattern could suggest that differences involving aversive words may make some individuals more likely to seek out novelty than others, but the interaction was not replicated in Study 2. At best, individual differences in novelty seeking should be examined in future studies involving motivation and perception.

There was also a significant three-way interaction between achievement seeking, word type, and manipulation condition. Graphs of estimated means for this interaction show that high achievement seekers showed the expected pattern to a greater extent in the control writing condition. I interpreted this finding in terms of default behavioral tendencies that were eliminated in the motivation writing condition. However, the relevant interaction did not replicate in Study 2.

A more likely explanation is that the individual difference variables used were not as closely linked to dopamine reactivity as had been hoped. Dopamine activity in human beings can only be indirectly assessed, but surely there are better ways of assessing it than using self-report scales. Thus, I argue that before the dopaminergic component of the

model is dismissed, future studies should be conducted with more direct measures of dopamine activity.

Tentative Support

Given the lack of findings noted above, it is apparent that the validity of the model is in question. However, the normative findings, and findings involving the daily variables, do provide some support. In both studies, bias scores for appetitive words were significantly larger than bias scores for aversive or neutral words. This is consistent with the general idea that implicit motivation can make goal-related stimuli appear larger, presumably to induce or bias approach behavior.

Unexpectedly, aversive words were also perceived to be larger than neutral words in both Studies 1 and 2. This was not predicted by the model, but an expanded model of a similar type could explain the latter systematic bias as well. Specifically, just as closer proximity to an appetitive stimulus should invigorate approach behavior, closer proximity to an aversive stimulus should invigorate avoidance behavior (Hull, 1943; Miller, 1944). Therefore, I propose that motive relevant stimuli in general bias perceptions in order to facilitate their associated behaviors. It is unlikely that dopamine mediates the findings for aversive words, but the bias was greater for appetitive words.

Though there were no direct relationships between affective size perception and any of the daily outcomes, there were two significant cross-level interactions. Positive events resulted in increased motivation to overcome obstacles and more achievement motivation for individuals who perceived appetitive words to be larger than neutral words. These findings are highly consistent with the model and indicate that perceptual biases are more closely associated with reward reactivity than invariant tendencies. Thus, it appears

to be particularly important to consider precipitating events when making predictions concerning appetitive enhancement as an individual difference variable.

It is important to note that appetitive enhancement did not moderate slopes between positive events and positive affect. This dissociation may reflect a difference in wanting vs. liking. Berridge (2007) suggests that dopamine in particular and approach motivation more generally involves wanting and seeking desirable incentives rather than pleasure in obtaining them. From this perspective, the results of Study 2 make a great deal of sense.

In sum, though overwhelming support for the proposed model was not found, the positive results that were obtained suggest that it is still too early to classify the model a complete failure. First, in both studies appetitive words were perceived to be larger than aversive or neutral words. This is consistent with the model and previous theory regarding perceived size and motivation. Second, the difference in size perception between appetitive vs. neutral words predicted reward reactivity in daily life. More work of the latter type is advocated.

Future Directions

Given the results indicated in the previous section, it would seem prudent to preserve the model as it is now and retest several hypotheses in an improved manner. Because approach motivation is believed to be the main moderator of the size-perception relationship, I propose conducting a new study that manipulates motivation, but this time in the context of a manipulation whose content better matches the nature of the stimuli subsequently judged. I view evidence of this type as crucial for the causal implications of the model.

Additionally, future studies could benefit from examining individual differences that are more closely related to dopamine reactivity or more specific to the variables being assessed. Genotyping could be an option, but given the exploratory nature of the studies it would likely not be worth the expense. A more attractive alternative would be to assess eye-blink rates. Individuals high in basal dopamine have been shown to blink their eyes more frequently than others (Chermahini & Hommel, 2010). A head mounted eye-tracker could be useful in exploring relations between eye-blink rates and size perception. Moreover, it would be highly informative to examine whether the desirability of the stimulus modulates blink rates in the manner indicated by the model presented in the introduction.

An additional route for future research would be to explore the functional significance of the perceptual difference between aversive and neutral words. This difference could provide valuable insight into the operation of behavioral avoidance systems. I would expect greater biases of this type to predict behaviors associated with caution, vigilance, or anxiety. Also, given the results, a broader model involving the motivation-perception interface might be advocated.

Concluding Remarks

Ultimately, even if the model I have constructed is proven to be incorrect, it is my hope that future researchers will continue to follow such a systematic approach. It is my belief that it is important to develop a deeper understanding of a very robust and potentially important bias to perceive desirable objects as larger. A systematic, model-based approach would hopefully help this line of research avoid the pitfalls that that befell the original New Look while providing a guide to future research.

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APPENDIX A. WORDS USED IN THE SIZE-ESTIMATION TASK

Appetitive	Neutral	Aversive
ADMIRATION	APPLIANCE	AGONY
AFFECTION	BARREL	ANGUISH
APPROVAL	CHAIR	CRITICISM
AWARD	CLOCK	DEFEAT
BLISS	COLUMN	DISASTER
COMFORT	CONTENTS	DISCOMFORT
ENJOYMENT	CORD	DISEASE
FULFILLMENT	CORRIDOR	DISTRESS
GRATIFICATION	CURTAINS	FAILURE
HAPPINESS	DOOR	HARDSHIP
HONOR	HAIRDRYER	HARM
JOY	HYDRANT	ILLNESS
PEACE	JOURNAL	MISERY
PLEASURE	MACHINE	PAIN
PRIZE	PART	PUNISHMENT
REWARD	RATTLE	TORMENT
SATISFACTION	RESERVED	TORTURE
SECURITY	SEAT	TRAGEDY
SUCCESS	TRUNK	TRAUMA
WARMTH	UTENSIL	TROUBLE

APPENDIX B. PERSONALITY ASSESSMENTS

Novelty Seeking

Instructions: You will see a series of statements that may describe you well, or not at all. Indicate how well each statement describes you by choosing numbers from the following scale, and placing them in the blanks preceding the statements.

1 = very inaccurate
2 = moderately inaccurate
3 = neither inaccurate nor accurate
4 = moderately accurate
5 = very accurate

1. Prefer variety to routine.
2. Love to think up new ways of doing things.
3. Am open to change.
4. Enjoy hearing new ideas.
5. Seek adventure.
6. Like to begin new things.
7. Like to visit new places.
8. Don't like the idea of change.*
9. Dislike changes.*
10. Prefer to stick with things that I know.*

Items marked with an * were reverse scored. All times were averaged together to create a composite measure of Novelty Seeking.

Sensitivity to Reinforcement of Addictive and Other Primary Rewards

Use the following rating scale when answering the questions below:

1 = somewhat
2 = slightly
3 = moderately
4 = very
5 = extremely

A. Think about your most favorite food
   1. How pleasant would it be to eat it right now?
   2. Do you want to eat it right now?
   3. How pleasant is eating it in general?
   4. How much do you want to eat in general?
   5. How pleasant was eating it the last time you were high/buzzed?
   6. How much did you want to eat it the last time you were high/buzzed?

B. Think about your most favorite sexual activity
   1. How pleasant would it be to do it right now?
   2. Do you want to do it right now?
   3. How pleasant is doing it in general?
   4. How much do you want to do it in general?
   5. How pleasant was doing it the last time you were high/buzzed?
   6. How much did you want to do it the last time you were high/buzzed?

C. Think about your most favorite drug or alcohol
   1. How pleasant would it be to use/drink it right now?
   2. Do you want to use/drink it right now?
   3. How pleasant is using/drinking it in general?
   4. How much do you want to use/drink it in general?
   5. How pleasant was using/drinking it the last time you were high/buzzed?
   6. How much did you want to use/drink it the last time you were high/buzzed?

STRAP-R Food = (A1 + A2 + A3 + A4 + A5 + A6)/6
STRAP-R Sex = (B1 + B2 + B3 + B4 + B5 + B6)/6
STRAP-R Drugs = (C1 + C2 + C3 + C4 + C5 + C6)/6
STRAP-R Average = (STRAP-R Food + STRAP-R Sex + STRAP-R Drugs)/3

Achievement Seeking

Instructions: You will see a series of statements that may describe you well, or not at all. Indicate how well each statement describes you by choosing numbers from the following scale, and placing them in the blanks preceding the statements.

1 = very inaccurate
2 = moderately inaccurate
3 = neither inaccurate nor accurate
4 = moderately accurate
5 = very accurate

1. Work hard.
2. Do more than what's expected of me.
3. Continue until everything is perfect.
4. Excel in what I do.
5. Work too much.
6. Plunge into tasks with all my heart.
7. Do just enough work to get by.*
8. Am not highly motivated to succeed.*
9. Do too little work.*
10. Have a slow pace to my life.*

Items marked with an * were reverse scored. All items were averaged together to create a composite measure of Achievement Seeking.

APPENDIX C. DAILY ASSESSMENT

Daily Achievement Motivation and Motivation to Overcome Obstacles

Below are different goals/motivations that you may or may not have had today. To what extent did you have each of the following goals?

1 = not at all true today
2 = only slightly true today
3 = distinctly true today
4 = very much true today

1. was motivated to ACHIEVE something. (Achieve_01)
2. was motivated to ACCOMPLISH things. (Achieve_02)
3. was motivated to OVERCOME obstacles. (OvercomeObs_01)
4. was motivated to RESOLVE a problem. (OvercomeObs_02)

DailyAchieve = (Achieve_01 + Achieve_02)/2
DailyOvercomeObs = (OvercomeObs _01 + OvercomeObs _02)/2

Daily Appetitive Thoughts

Indicate the extent to which you agree with the following statements concerning today.

1 = strongly disagree
2 =
3 =
4 =
5 = strongly agree

1. I thought about stuff I wanted. (AppedThought_01)
2. I was thinking about desirable outcomes. (AppedThought_02)

DailyAppedThought = (AppedThought_01 + AppedThought_02)/2

Daily Positive Affect

To what extent did you feel each of the following today? Use the scale below:

1 = not at all
2 = a little
3 = moderately
4 = quite a bit
5 = extremely

1. Enthusiastic (PosAffect_01)
2. Excited (PosAffect_02)

DailyPosAffect = (PosAffect_01 + PosAffect_02)/2

Daily Impulsive Behavior

How many times did you do the FOLLOWING BEHAVIORS TODAY?

0 = not a single time
1 = one time
2 = two times
3 = more than two times

1.was self-indulgent (Impulsive_01)
2.bought something on impulse (Impulsive_02)
3.gave in to an urge (Impulsive_03)

DailyImpulsive = (Impulsive_01 + Impulsive_02 Impulsive_03)/3

Daily Positive Events

Please indicate for each of the following experiences how much it has been a part of your day.

1 = not at all true today
2 = only slightly true today
3 = distinctly true today
4 = very much true today

1.something good happened today (PosEvent_01)
2.experienced a lot of pleasant events (PosEvent_02)

DailyPosEvent = (PosEvent_01 + PosEvent_02)/2

Daily Goal Persistence

Rate the extent to which each behavior occurred when you were trying to achieve your goals

1.Was Not Discouraged By Setbacks (1) – (2) – (3) – (4) – Was Discouraged By Setbacks (5) (GoalPersist_01 - Reverse-Scored)
2.Often Quit After Starting (1) – (2) – (3) – (4) – Finished What I Started (5) (GoalPersist_02)
3.Was Rather Lazy (1) – (2) – (3) – (4) – Worked Very Hard (5) (GoalPersist_03)

DailyGoalPersist = (GoalPersist_01R + GoalPersist_02 + GoalPersist_03)/3