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# Self-Awareness, Perspective-Taking, and Self-Face Recognition

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## ABSTRACT

Self-Awareness, Perspective-Taking, and Self-Face Recognition

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The variable effects of self-awareness may be a result of multiple states of awareness being condensed under the umbrella term, “self-awareness”. We posit that the cognitive and behavioral effects of self-awareness are largely dependent on another variable, level of abstraction, which modulates self-awareness on a continuum between conceptual and perceptual processing. We support this claim with evidence suggesting that conceptual self-awareness works to override one’s perceptual self-awareness in the perception of one’s own face, and that this process is mediated by perspective-taking. When asked to differentiate their own mirrored and unmirrored faces from other faces, participants who were asked to think about themselves as abstract social entities showed faster recognition of their own unmirrored faces, compared to participants who were asked to focus on more perceptual aspects of themselves. We also present evidence suggesting a protective effect of conceptual self-awareness in skilled motor performance, using a penny golf task.

For Satoru and Marcia.

Your scientific purity and agility in outwitting bureaucracy kept me in graduate school. I thank you.

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## 1. INTRODUCTION

The effects of self-awareness are variable. Subjectively, the self-awareness felt while giving a speech in front of a large audience is of marked qualitative difference from the self-awareness that is experienced during a breathing meditation, or while focusing on the sensations of one's heartbeat. Experimentally, self-awareness may either increase or decrease feelings of causal agency (Silvia & Duval, 2001), either help or hurt skilled motor performance (Beilock & Carr, 2001; Butler & Baumeister, 1998), and introspection may or may not lead to accurate self-knowledge (Brown & Ryan, 2003; Silvia & Gendola, 2001). These inconsistent effects may be a result of multiple states of awareness being condensed under the umbrella term, "self-awareness". We posit that the cognitive and behavioral effects of self-awareness are dependent on another variable, level of abstraction, which modulates self-awareness on a continuum between conceptual and perceptual processing. We support this claim with evidence suggesting that conceptual self-awareness works to override one's perceptual self-awareness in the perception of one's own face, and that this process is mediated by perspective-taking. We also present evidence that suggests a protective effect of conceptual self-awareness in skilled motor performance.

**Conceptual and Perceptual Processing:**

"Life is what happens while you're busy making other plans."

-John Lennon

Human attention is of limited capacity (Kahneman, 1973; Norman & Bobrow, 1975), and there are two broad sources of information competing for the spotlight of our attention at any given moment. Conceptual information, about the way the universe has been in the past and will be in the future, competes for attention with perceptual information about the way the universe looks (feels, tastes, smells, sounds, etc..) to us right now (Bonanno & Singer, 1993). The higher our level of abstraction, the more conceptual information makes it into our awareness. Given that our attention is of limited scope, an increase in conceptual attention lessens one's perceptual attention, reflecting a higher level of abstraction. Theories of constructive perception posit that top-down conceptual information motivates what we obtain from perception (Rock, 1983). Experimentally, past experience informs our present concepts and future predictions (Buehler & McFarland, 2001), and attention to the past and future is likely conceptual. Abstract thinking can be very helpful in accommodating the overabundance of infinitely reducible stimuli in our environment to fit our meager attentional capacities, but these shortcuts come at the price of sacrificing our awareness of the nuances of individual stimuli. We see this in the stereotyping literature, where categorizing someone by race (conceptual) reduces one's ability to extract individuating perceptual information about a person, leading to recognition deficits for easily-categorized outgroups (Bothwell & Brigham, 1989; Malpass & Kravitz, 1969; Meissner & Brigham, 2001). In addition, briefly presented other-race faces are categorized more readily by race than faces that are the same race as the observer. Perceptual other-race “markers” (i.e. lips, nose, skin tone), once noticed, may shut down individuation processes and alter one’s perception of an other-race face to be consistent with categorical exemplars for that race (Levin & Angelone, 2002; MacLin & Malpass, 2003). Further, cognitive load has been demonstrated to increase peoples’ likelihood of attributing stereotypical traits to an out-group member (Wigboldus, Sherman, Franzese et al., 2004), supporting the idea that categorization is an efficient strategy for dealing with stimulus over-inclusion.

Every day, we allow our conceptions of the world to override our perceptions, making the world less terrifying, easier to process, and often leading us to overlook perceptual information that doesn't fit our expectations. When presented with a visual scene, we tend to see only what we need to see, in order to satisfy our pre-defined goals and task parameters. This is demonstrated experimentally by participants who do not notice size changes in a fixated object unless those changes are relevant to a concurrent sorting task (Triesch, Ballard, Hayhoe et al., 2003). Our attention to visual scenes appears to be transient, with blatant disruptions of a stimulus on the order of 200-600 ms often going unnoticed (Levin & Varakin, 2004). There is no evidence for blind spot-style perceptual filling-in driving these effects, so it is likely that continuity of a scene as an abstract entity is preserved by higher-order processing (Levin & Simons, 2000; Noë, Pessoa, & Thompson, 2000). These lapses in visual awareness are further illustrated by a phenomenon known as change blindness, in which one does not notice a change between two similar stimuli (O'Regan, Deubel, Clark et al., 2000). Dubbed "seeing without seeing", this effect is particularly strong when the two stimuli are presented very briefly, and when one is under a cognitive load manipulation (Angelone, 2004). Competition between conceptual and perceptual processing might be the mechanism behind this phenomenon. Just as we are more likely to stereotype people when our cognitive resources are limited, we may be more likely to abstract other stimuli into categories, thereby missing individuating information about each unique stimulus. For example, if we categorize a man by age, race, or gender, what we "see" are those concepts in our representation of the man, and as long as none of these categorizations are violated, the man could be easily replaced by any number of other men without our noticing the change in individuating information. This is supported by research showing that viewers were less likely to notice a change in a scene when they were trained to think of the changing object in terms of its broad category membership than when they thought of the object in more specific terms (Archambault, 1999).

Physiologically, change-detection is correlated with activity in the parietal cortex (Koivisto & Revonsuo, 2003; Pessoa & Ungerleider, 2004), and disabling the right parietal area with transcranial magnetic stimulation augments the change blindness effect (Beck, Muggleton, Walsh et al., 2006). It may seem odd that change blindness is affected by stimulation outside of primary visual cortex, but if the mechanism for change-blindness is sacrificing the perceptual for the conceptual, then it makes sense that the parietal cortex would be implicated. When the electrophysiological activity of categorization (conceptual) and individual recognition (perceptual) are compared, recognition is marked by parietal activity on the order of 400-800 ms, while ERPs related to early visual processing (NI – 156-200ms) are correlated with categorization (Curran, Tanaka, & Weiskopf, 2002). This supports the idea that individuation takes longer than categorization, and helps to explain why we might fall back on categorization when under cognitive load or when stimulus presentations are brief. It is also interesting to note that parietal cortex is implicated both in individuation and in self-processing, as noted earlier. In persons with acute brain injury, preserved self-awareness is mediated by categorization ability, and it is a critical predictor of successful everyday functioning (Gorerover, 2004).

Spontaneous categorization is observable in children between 7 and 11 months of age, and the perceptual world becomes increasingly differentiated as new stimuli and patterns are encountered (Mandler & McDonough, 1998). Early categories tend to be based on concrete perceptual affordances (i.e. hammer and nail), while more advanced conceptual categories (i.e. nail and pin) develop with age (Denney, 1974). With regard to aging, “older and wiser” might simply be a function of seeing the world more abstractly and conceptually with age. Not only does this allow us to bring past conceptual knowledge to bear on the present environment, but it also allows us to process more of the world at once by categorizing familiar stimuli and reserving cognitive resources for processing novel events. However, this increased reliance on past frameworks might be the reason for the diminished ability to learn new skills with age (Harrington & Haaland, 1992; Parasuraman & Giambra, 1991; for evidence of age-related learning deficits), because these skills may not fit into our existing framework. Perhaps when Chomsky speaks of the "social indoctrination" that solidifies with age and degree of institutionalization (Chomsky, 1987, 1989), he is referring to an increased propensity toward adopting socially-defined abstractions about the world, and the tendency for these abstractions to become a person's reality, evidenced by the idea that we can wage war on an abstract concept, such as "terror". This process of abstraction could explain the infamous generation gap as a difference in how two generations "view" the world. The same percepts are filtered downstream through different conceptual frameworks, leading not only to disparate conceptualizations of the world, but also an inability of each generation to understand how the other could possibly make seemingly irrational decisions (all equally "logical" when based on their respective conceptual frameworks). These filtering mechanisms may be governed by top-down cortical influences, facilitated by reciprocal connections between higher-level cortical areas and areas responsible for low-level perceptual processing (Mesulam, 1998; for a review).

If certain concepts are routinely paired with certain percepts, it would be maladaptive to ignore this conceptual information in most cases, except for when subtle perceptual differences nullify the predictive merit of the concept. Returning to the example of race perception, a young person from an all white suburb might not understand the reluctance of his grandfather to trust black people, because the young person has had less experience with black people, and views them simply as the superordinate category, “people”. The older person, on the other hand may have encountered more people of low socio-economic status (one section of the population where African-Americans are unfortunately overrepresented), and likely had some bad experiences along the way. This conceptual information (however confounded) about black people replaces perceptually individuating information about individuals with this melanin concentration. However, this reliance on skin color as a predictor could lead the older person to miss perceptual cues that would be advantageous to notice (Neuberg, 1992), like if the black person were the CEO of Merrill Lynch visiting with a job offer, an opportunity lost by the risk aversion (Bakshi & Chen., 1994; Palsson, 1996) and abstract thinking developed with age. If it is true that our “circle of empathy” maxes out at around 150 people (Buys, 1992; Buys & Larson, 1979; Dunbar, 1992, 1993), it is impossible to truly represent everyone as an individual, an effect that would become more pronounced as one’s circle becomes more crowded with age and experience. In addition, age-related cognitive declines might lead older people to categorize along conceptual lines more readily to preserve cognitive resources. However, there is evidence for a reversal of this trend at very advanced ages (Denney, 1974).

If we think about how we see the world now versus how we saw it as a child, we may find that we think about things in the abstract to such an extent that we rarely ever "just see things". As previously mentioned, this could be the mechanism behind change blindness, where we are representing a tree as a generic tree, rather than a specific tree, and so we miss superficial changes that would identify the tree as a novel tree, while still maintaining its basic category membership. This reliance on iconic and categorical thinking becomes very evident when asking a non-artist to draw a picture of her friend's face. We will get two eyes, a nose, a mouth, some hair, and it will look nothing like the friend, because the person drawing is not actually seeing the friend perceptually, but rather conceptually, translating into an iconic representation of the subject (Edwards, 1999). One of the first things taught to new artists now is how to see things perceptually. This is also part of the training for meditators wishing to attain the "Shamatha" (or similar) state, in which the world and the self are experienced without labeling or abstraction, reflecting a reduction in conceptually-driven processes (Hayward, 1998).

The obscuring of perceptual information by conceptual information is further illustrated by a phenomenon known as verbal overshadowing. Here, we find that eyewitnesses who are asked to describe a suspect immediately after a crime are less likely to accurately pick the suspect out of a lineup (Schooler & Engstler-Schooler, 1990), and non-experts asked to describe their experience of a wine are less likely to recognize the wine upon later presentation (Melcher & Schooler, 1996). Schooler attributes this phenomenon to a transfer-inappropriate processing shift, in which subjects might drift into a conceptual "mode", abstracting their percepts, and replacing the referent with its symbol, thereby losing individuating perceptual information (Schooler, 2002). The tendency for conceptual processing to interfere with perceptual awareness might be due to their common biological underpinnings, with modern conceptual faculties having evolved on top of earlier perceptual hardware (Goldstone & Barsalou, 1998). For example, complex concepts are made easier to understand using perceptual analogs, and people spontaneously engage in perceptual simulation to solve higher-order conceptual tasks. We also find that processes involved in framing-effects, reference dependence, and heuristic-based decision making, follow perceptual analogs of field-dependent contrast detection and perceptual averaging (Kahneman, 2003). Because of this scaffolding and similarity, Goldstone advances the idea that conception and perception are not separate types of processing, but the same processes varying on the continuum of level of abstraction.

The conceptual/perceptual distinction gets more complicated when we talk about visualization, because if we visualize a flower, the subjective and biological experience is very similar to actually seeing a flower (Farah, Péronnet, Gonon et al., 1988; Finke, 1989; Roland & Friberg, 1985). However, this flower is likely built on encoded representative exemplars of the category “flower” that we have experienced in the past, which have been broken down into their component features (color, shape, texture, smell, etc) for storage, and reconstructed for entry into our awareness (Ashby, Prinzmetal, Ivry et al., 1996; Hanna & Remington, 1996). While we are aware of an imagined flower, our attention is necessarily directed to its antecedent concepts, and it is attention, not the resulting awareness, which determines level of abstraction in our definition.

**Self-Awareness:**

We can attend to other-stimuli (environmental stimuli or thoughts about others), and we can attend to self-stimuli (thoughts about and percepts of the corporeal or abstract self). For this research, we make the materialist assumption that focusing on one’s bodily sensations is indeed focusing on oneself. Attention to self diminishes attention to non-self stimuli (Duval & Wicklund, 1972). For example, self-aware people perform poorly in a task of discriminating between other people-stimuli (Vallacher, 1978). Self-focus is a correlate of self-awareness, though not necessarily of accurate self-knowledge (Silvia & Gendola, 2001; for a review).

This idea of self-directed awareness is often muddled with self-recognition. Many of the early techniques for studying the self relied on self-recognition measures as evidence of self-awareness. The classic task for non-human primates is the Gallup Mirror Task, in which a mark is placed on the face of an anaesthetized animal, and the animal is situated in front of a mirror (Gallup, 1970). Upon waking, i the animal does not recognize its reflection as its own, it will exhibit “social” behaviors (i.e. playing, courting, attacking, hiding, etc..), as if it were in the presence of another being.  If the animal recognizes itself in the mirror, it will make some attempt to examine or remove the mark on its own face, and results are quantified by the number of touches to the mark in a given period.  This self-recognizing behavior does not occur in younger apes, but it does emerge in chimpanzees at about four years of age.  These findings are consistent in orangutans, dolphins, and possibly gorillas (Lethmate & Ducker, 1973; Reiss & Marino, 2001; Robert, 1986; Shillito, Gallup, & Beck, 1999; Suarez & Gallup, 1981).  Most importantly, these results extend to human children, who begin to consistently pass the mirror task at approximately two years of age (Amsterdam, 1972).  The mirror task allows us to infer, without much reservation, that the subject in front of the mirror is capable of self-recognition, but making the leap to self-awareness requires more evidence.  One very important finding is that both humans and chimps show a marked increase in performance on the mirror task upon the emergence of personal pronoun use, verbal in humans and hand-signed in chimps (Imbens-Bailey & Pan, 1998).  We also see a strong correlation between success on the mirror task and the expression of “self-emotions”, such as frustration and guilt (Lewis, 1994, 1997).  This suggests that self-recognition is contingent on self-awareness, but the two are not synonymous, and the relationship is asymmetrical.  We speculate that a person without sight can feel self-aware.  One could even imagine a person with only one functioning sense being aware that he or she is the perceiver of that sensory input, or a person with no sensation at all being aware of his or her own thoughts, so self-recognition does not seem to be a prerequisite for self-awareness.

The ability to focus “properly” on the self is a consideration in neuropsychology, in which we see the importance of the right hemisphere of the brain (the right temporal-parietal junction, in particular) in maintaining a “normal” sense of self.  One disorder, prosopagnosia, can include an inability of the patient to recognize his or her own face in a mirror (Biran & Coslett, 2003). In a similar phenomenon, termed “mirror sign” after a 77 year old deaf woman who was observed trying to communicate through sign language with herself in a mirror, patients are unable to recognize themselves in a mirror, though recognition for other people is preserved. Cases of mirror-sign are very rare, but this disrupted visual self-recognition is accompanied by damage to the right parietal region of the brain (Breen, Caine, & Coltheart, 2001; Feinberg & Shapiro, 1989). Even more striking than these mirror deficits is asomatognosia, in which the patient fails to recognize his or her own body parts, even when looking directly at them (Feinberg, 1997, 2000). This disorder is accompanied by damage to the right temporal-parietal junction (TPJ). Interestingly, when people project their perspective outside of their bodies, either voluntarily or spontaneously, the right TPJ is also implicated. When “normal” subjects are asked to take the perspective of a line drawing of a human, they show increased activation of the right TPJ, and selective interference with this brain area using transcranial magnetic stimulation (TMS) disrupts their perspective-taking ability (Blanke, Mohr, Michel et al., 2005). In addition, applying TMS to the right TPJ can, at low levels, produce the sensation of body distortions, such as a feeling of shortening or movement of one’s limbs (Blanke, Ortigue, Landis et al., 2002). At higher levels of stimulation, it can produce full-scale out of body experiences, in which one’s perspective appears to shift from inside one’s body to above oneself, looking down. While usually not as troubling as the asomatognosic’s persistent inability to recognize his or her own body parts, we speculate that the common underlying physiology of these body distortions suggest a crucial role of the right TPJ in preserving our sense of a stable self in space.

It is unknown how stable our attention is to self or other during normal functioning, but there is evidence to suggest that it oscillates between the self and the surrounding field similar to figure-ground reversals seen in phenomena such as the vase-face illusion (Rochat, 2003; Snow, Duval, & Silvia, 2004; Travis, Arenander, & DuBois, 2004). If the fluctuation is not consciously noticeable, it is likely gradual, since human perception is often reference dependent, based on comparison and the detection of change, rather than absolute (Kahneman, 2003). Alternatively, shifts in awareness could be acute but unnoticeable if there is a mechanism for suppressing awareness during shifts, similar to the way that saccades do not produce the subjective feeling of visual motion (Thilo, Santoro, Walsh et al., 2004). In each case, suppressed attention to change works to preserve a sense of stable conscious awareness, allowing consistent processing of environmental demands.

Some researchers have proposed individual differences in trait self-awareness, termed self-consciousness (Buss, 1980). In the absence of manipulations, we should expect these differences to be stable, with some people naturally spending more time focused on themselves. This is relative to "state" self-awareness, our main independent variable in this paper, which is transient and brought about by local stimuli. Evidence that private self-consciousness, with a focus on the abstract self-concept, leads to greater self-report reliability than induced self-awareness suggests that the two are not qualitatively equivalent (Nasby, 1989). In the following pages, we suggest that attention to either abstract or perceptual features of oneself might lead to marked differences in both subjective experience and in performance.

**Conceptual and Perceptual Awareness of the Self:**

"I is someone else."

-Arthur Rimbaud

When the self is the primary content of one's awareness, we should expect two phenomena. First, we expect that the subjective quality of one's self-awareness will vary, based on level of abstraction, on a continuum between conceptual and perceptual self-awareness. Second, we expect that being conceptually self-aware will overshadow one's perceptual awareness of oneself.

Because the study of self-awareness is relatively new in Western psychological science, there is a good deal of overlapping terminology, originating from various sub-fields of psychology. Some terms describing observed divisions in self-awareness are analytical versus experiential self-awareness (Watkins & Teasdale, 2001, 2004), objective versus subjective self-awareness (Silvia & Duval, 2001), and abstract versus concrete self-awareness (Leary, Adams, & Tate, 2006). Making the conceptual and perceptual distinction not only helps to unify these terms, but it is also grounded in more general theories of cognition and abstraction. It is also a division proposed by Legerstee in a model of childhood development, in which infants possess both a perceptual and social awareness of themselves (Legerstee, 1998).

When applied to self processing, high level of abstraction means that more conceptual information about the self is held in one's awareness (the symbolic self, containing known weaknesses, abstract ideas about self worth, social comparisons between the conceptual self and normative cultural images, etc...). This leads to one's awareness of the self as perceived by others, our operationalization of conceptual self-awareness. Abstraction is a prerequisite for projecting one's viewpoint to that of another or of society as a whole. Low level of abstraction means that perceptual information about the self dominates (non-verbal sensory awareness, experiencing "feelings" without abstraction or egoism, and heightened awareness of the body's processes), and this is what we term perceptual self-awareness.

It is important to note the sub-verbal aspect of perceptual self-awareness. This is awareness without labeling, and it is necessary for perceptual awareness (as we see in the stereotyping/categorization literature), because the social contract of language mandates that the common meaning of a word encompasses the unique qualitative experience that every person has of the real-world object or event that it represents, ironically ensuring that words never accurately describe the perceptions of any one person. Pure perceptual self-awareness is probably never (or rarely, by those who practice it) achieved, as the level of abstraction variable is continuous, rather than discrete. This is also why we use the term "perceptual", rather than "sensory", to describe unabstracted processing. Truly, an exclusively sensory existence would be an unmanageable one, as important basic knowledge about the world would be forfeit, such as the fact that gravity holds things down or that relative size signals depth. Therefore, the perceptual/conceptual distinction should be viewed as a continuum, with pure sensory awareness being the difficult-to-attain extreme of the perceptual pole.

Knowing that attention is a limited resource, attention toward one pole of either dimension (conceptual/perceptual or self/other) diminishes attention toward the other pole, and we speculate that there is a constant complementary fluctuation between the two poles. This is necessary, because one needs current perceptual feedback to inform one's knowledge of one's actual self. Revisiting the example of mirror sign in prosopagnosics, Spangenberg and colleagues observed an 82 year old woman, whose self-recognition deficits were supplemented by past conceptual information about herself, leading her to see herself in the mirror as a young girl who looked like her (Spangenberg, Wagner, & Bachman, 1998). This interplay between the perceptual and conceptual is evidenced by the body distortions that mark eating disorders, such as anorexia. We speculate that, fed by conceptual knowledge about what the "perfect body" is supposed to look like, the anorexic's perceptions may be altered unfavorably by comparison and counterfactual thinking. These distorted percepts may inform her knowledge about her actual self, and this is again compared to the ideal self, creating a vicious cycle (Epstein, Wiseman, Sunday et al., 2001; Gordon, 1990). It is in this comparison between the perceived and ideal self, where experimenters predict the often intense discomfort caused by being conceptually self-aware (Silvia & Duval, 2001; for a review of objective self-awareness theory).

The pleasurable effects of reducing conceptual self-awareness may explain the perceived up-side of one of society's long-standing indulgences, alcohol, which seems to dampen higher-level conceptual processing (Jones, 1972), or at least one's attention to it, leaving the user with a clearer feel for how his perceptual system is representing his immediate environment. Consumption of alcohol can lead the user to focus on salient information in his or her immediate environment (Carey, 1995). In addition, alcohol has an inhibitory effect on involuntary shifts of attention (Jaaskelainen, Schroger, & Naatanen, 1999). This may translate into extended periods of perceptual self-awareness, when attention is focused toward the self, as well as prolonged attention to an external stimulus (i.e. a beer glass) when attention is focused toward the environment. With attention turned away from social demands on the abstract self, alcohol might also loosen up the user's aversion to risk and resistance to change (Marinkovic, Halgren, Klopp et al., 2000; Vuchinich & Calamas, 1997; for evidence of alcohol's relationship to impulsivity).

Familiarity breeds liking (Zajonc, 1968), and since we are likely more familiar with ourselves than with anyone, we are often reluctant to make permanent changes in ourselves (Silvia & Gendola, 2001). This is not to say that we don't enjoy a hiatus every now and then, as evidenced by our consumption of psychoactive drugs. Again, one of the most ubiquitous of these drugs is alcohol, which can lead the user to dissociate, disinhibit, and do things that "they" would never do. Perhaps this is why alcohol is used palliatively during periods of personal flux

(Hill & Angel, 2005), such as a job layoff or a funeral wake, to lubricate the mechanisms of change and make the reconceptualization of the abstract self less painful. Conceptual self-awareness can also dampen emotional processing in times when there is no obvious standard for how to act (Silvia, 2002), so by inhibiting the abstract self, we speculate that a person can find greater connection to his or her emotions without “labeling them away”, and harness this intense emotionality to enact meaningful change in the self. This sort of transformation is something that is generally resisted by the sober population.

SA is thought to increase consistency motivation, a desire for greater cohesiveness and stability of the self over space and time (Berkowitz, 1975; Duval & Wicklund, 1972), and self-awareness is correlated with higher subjective levels of self-consistency (Kernis & Grannemann, 1988). This translates into a lessened susceptibility to allowing social influences to affect our perceptions and attitudes (Davies, 1982). Institutional situations such as cult indoctrination and boot camp both seek to increase conformity and deindividuation of inductees by annihilating their awareness of themselves as unique individuals (same clothes, same titles, same haircuts, collective ritual, etc…). On a larger scale, perhaps the motivation towards consistency is a result of social mandate and one will take any excuse that they can to temporarily dodge their roles as social animals. Various meditative traditions facilitate individual change by instructing the practitioner on how to annihilate the self, and the extreme scenario of packing up and living on a mountain top or a hermitage can lead to some of the most profound departures from mainstream thought. Normative social pressure can be avoided by vows of silence and intensive daily meditation. By focusing on the present slice of space-time, away from the sphere of others’ influence, free from past experience and future prediction, a person has the freedom to act in discordance with persistent models of who he or she "is" without experiencing the cognitive dissonance that occurs when these models of self-concept are active. We speculate that the appeal of the monastic life would be much stronger to those of us who would like to deviate from the norm in a substantial way, and this might be moderated by the degree to which a person is "field dependent", or sensitive to normative pressures from his or her environment.

Since conceptual self-awareness is often social in nature, inspired by the covenant of language, this perspective-taking ability is likely why we see the emergence of social emotions like guilt and embarrassment at around the age of two (Lewis, 1994, 1997), the approximate age at which infants begin to show mirror self-recognition. We find more evidence for perspective-taking in conceptual self-awareness when participants are made conceptually self-aware by the presence of a video camera or by hearing their own recorded voices. Under these conceptual self-awareness manipulations, participants are more likely to complete the task of drawing an "E" on their foreheads by drawing it so that it would appear normal to an outside observer, while those subjects who are not conceptually self-aware tend to draw the letter backwards, as it would appear to themselves if the inside of their foreheads were a piece of paper oriented towards them (Hass, 1984). If people who are thinking about themselves abstractly are actually taking the perspective of an outside observer, then we should expect them to be primed to recognize themselves as other people would see them. We also expect that focusing on immediate perceptual aspects of themselves would diminish this recognition of themselves from a social perspective.

## 2. EVIDENCE – Self-Recognition

### Experiment 1 - Self vs. Other Discrimination with Natural Faces

In order to examine how conceptual and perceptual awareness affect one's internal representation of oneself, we examined the speed at which participants were able to recognize their own faces. The self-face is a common stimulus for imaging studies of self-awareness, and experiments using self-faces as stimuli inform our knowledge that the self is processed preferentially by the right hemisphere of the brain. This is evidenced by a left-hand reaction time advantage for recognizing self faces over non-self faces (Keenan, McCutcheon, Freund et al., 1999), and the propensity to see self-other morphs as self when the left hemisphere is anaesthetized and other with an anaesthetized right hemisphere (Keenan, Nelson, O'Connor et al., 2001). People who score high on a schizotypal personality inventory do not show this advantage, which is consistent with other evidence of atypical self-processing in people with schizophrenia (Platek, 2003). Findings from self-face experiments are validated by the use of self-voices, which are more difficult to recognize than self-faces (Rousey & Holzman, 1967), because we very rarely hear our own voices unadulterated by the bone conduction produced by our vocal vibrations interacting with our skulls (Maurer & Landis, 1990). However, the same neurological correlates (right frontal) are found using voices and faces, despite the unfamiliarity of one's own voice (Olivos, 1967). This suggests that self-faces are actually activating a "self center" of the brain, rather than areas that are simply involved in recognizing familiar stimuli.

In the present study, the self-faces were presented either mirrored (as participants would see themselves in a reflection), or unmirrored (as other people would see them, or as they would see themselves in photographs), and subjects were tested on how quickly they were able to discriminate their own face from other faces. We predicted that when participants were thinking about themselves from a social perspective, they would be primed to recognize themselves as other people see them, and that we would not see this effect when participants were attending to more perceptual aspects of themselves.

*Participants:*

25 psychology undergraduates (10 male/15 female) participated in this experiment for partial fulfillment of course credit requirements. 20 of the participants were Caucasian (1 Hispanic), and 5 were Asian (2 East Asian, and 3 South Asian). One female subject was excluded, based on non-compliance with instructions, and because she smelled of marijuana.

*Procedure:*

After greeting the participant and obtaining consent, we photographed his or her face with a four megapixel digital camera. We then asked him or her to sit quietly for 10 minutes while we created the experimental stimuli from their photographs. In Adobe Photoshop, we cropped the face with an elliptical mask, so as to remove the jaw line, hair, and ears. We converted the face to grayscale, sized it to 200 by 273 pixels, brought its average luminance to 167 Photoshop luminosity units, and placed it on a background of Gaussian noise. The face was then flipped, creating two versions of the participant's face stimulus, one mirrored and one unmirrored.

Participants were assigned to each of 4 blocked conditions, counterbalanced for order. The instructions for each condition included a guided-attention task, followed by one minute of silence, during which they were asked to practice maintaining the instructed state of awareness to the best of their ability. This was followed by a quick refresher instruction, in the event that their attention was broken during the silence. All instructions were administered by recorded audio. In the "Perceptual Self" condition, participants were asked to focus on aspects of their breathing, with attention to the physical sensations that arose out of their breath. In the "Conceptual Self" condition, participants were asked to focus on more abstract properties of themselves, such as their strengths and weaknesses, how they would describe themselves in a job interview, and what makes them a good person. The "Perceptual Other" instructions were for participants to attend to sensory aspects of their environment, with a focus on the sounds, smells, textures, and light quality of the experimental room. In the “Conceptual Other” condition, participants were asked to focus on strategies that led to successful completion of the face recognition task. Full text of each manipulation can be found in Appendix A. Between each blocked condition, subjects were given a one minute period of silence, during which they were asked to clear their minds.

Each of the 4 main blocks consisted of 4 micro-blocks of 11 trials, with each micro-block followed by a refresher instruction to help participants refocus their attention. The stimuli for each micro-block were 6 self-faces (3 mirrored and 3 unmirrored) and 5 Asian and Caucasian, male and female “other” faces, presented in random order. The other faces were balanced across all micro-blocks for attractiveness, race (how Asian or Caucasian-looking the face appeared to be), and sex (how masculine or feminine the face appeared to be), as rated by 30 participants in a previous pilot experiment. The self and other faces were balanced for luminance. All stimuli were presented using SuperLab on a 17 inch Sony VAIO monitor, at a viewing distance of approximately 50 cm. Each trial began with two asterisks, flashed simultaneously in the left and right periphery of the screen for 100 ms, in order to draw attention away from the center of the screen. Because flashed stimuli momentarily capture attention (Jonides & Yantis, 1988), the peripheral asterisks were meant to diffuse participants’ spatial attention and encourage a more holistic processing strategy. The face was then presented for 175 ms, followed by a blank screen where subjects were asked to determine whether the face was “me” or “not me”, as indicated by pressing one of two buttons (Figure 1-1). We instructed participants to respond quickly, but more importantly, to maintain the instructed state of mind as best they could while responding to the faces. After logging each response, the experiment continued to the next trial automatically.

Before the actual experimental conditions, the participants completed 24 no-instruction practice trials, in order to familiarize them with the task.

After the face-recognition task, participants were given an unexpected recognition test of their memory for the other faces presented in the last block of trials. Participants were randomly presented with 20 "seen" faces and 14 "unseen" faces, and asked to indicate by button press whether they had seen each face in the previous block. Then, each P was given a set of questionnairres, assessing how frequently they looked in the mirror or saw pictures and video of themselves, whether they had experience in performance arts or contemplative traditions, and whether they considered themselves introverts or extraverts. Each subject also completed the Snyder Self-Monitoring Scale, to assess the degree to which they rely on social pressures to regulate their behavior.

*Results:*

In a 2x2 repeated-measures ANOVA, we examined the effect of conceptual self vs. perceptual self instruction on the speed (in milliseconds) at which participants recognized mirrored and unmirrored self faces. There were no significant main effects of instruction or type of face, but there was a cross-over interaction between the instruction and type of face, $F(1,23) = 8.26$, $p = .009$ (Figure 1-2). In the perceptual self (breathing awareness) condition, participants recognized their own mirrored faces significantly faster ($M = 331.02$, $SD = 105.2$) than their own unmirrored faces ($M = 375.8$, $SD = 182.34$), $t(23) = 2.22$, $p = .037$, while in the conceptual self (abstract self-concept) condition, there was no significant RT difference in recognizing mirrored and unmirrored self faces. There was no significant speed-accuracy tradeoff in this interaction.

We also examined RTs for mirrored and unmirrored faces in the conceptual other (strategies for completing the task) and perceptual other (immediate environmental awareness) conditions, in order to determine whether the previous interaction was due specifically to perceptual and conceptual self-awareness, or to perceptual and conceptual processing, in general. In the "other" instruction conditions, there was no significant interaction between instruction type and face type, so it appears that the effect is unique to the self-awareness instruction and not general perceptual or conceptual processing strategies. Although instruction type did not differentially affect mirrored and unmirrored faces, there was a significant main effect of type of instruction (conceptual vs. perceptual other), in which focusing on strategies for completing the task yielded faster overall RTs than attending to one's surroundings, $t(23) = 2.12$, $p = .045$. This provides a manipulation check, validating that participants were attending appropriately either to the task or to their environment.

For the memory task, we conducted a signal detection analysis of memory performance, calculating d prime for each participant. There was a significant effect of self or other focus, in which participants who were thinking about themselves during the face recognition task performed better ($M = .57$, $SD = .51$) in the recognition task than participants who were not thinking about themselves ($M = .197$, $SD = .35$), $t(22) = 2.1$, $p = .047$.

Based on a post hoc analysis of participants' questionnaire responses, we found that participants with contemplative experience (meditation, prayer, etc.) showed an unmirrored self-face recognition advantage (mirrored RT – unmirrored RT) when instructed to think about their own abstract qualities ($M = 29.53$, $SD = 28.08$), while participants without contemplative experience did not ($M = -1.26$, $SD = 30.79$), $t(22) = 2.38$, $p = .027$.

*Discussion:*

These results are evidence for two types of self-processing, conceptual and perceptual, as mediated by perspective-taking. By focusing on abstract self-qualities, we hypothesize that the participants' immediate percepts are obscured by a primed image of themselves, as seen by other people. This is evidenced by the speed at which participants recognize their own unmirrored faces, compared to their mirrored faces, in the conceptual-self condition, relative to the perceptual-self condition. By taking the perspective of an outside observer, participants may be calling photographs and video images of themselves to mind, priming them to recognize unmirrored self images. These recollected self-images may not be available when participants focus on themselves perceptually, and participants are less able to distinguish their unmirrored face from the face of a stranger. The participants' better performance on the memory task when they were in the self-focused conditions might be due to a self-referential memory advantage, in which the "other" faces were assigned self-relevance because participants were thinking about themselves, enabling better encoding of the faces (see Rogers, Kuiper, & Kirker, 1977, for a review of self-referential memory). Other subject variables, such as self-monitoring scores, did not prove to significantly predict performance, supporting the idea that trait and state self-awareness are qualitatively different constructs.

One might argue that the results are due to some artifact of reaction time research. Does a faster reaction time really mean that the subject is showing better recognition of a given face? A faster RT might be signaling differences in level of arousal, or response bias, rather than reflecting basic perceptual mechanisms. This is unlikely, due to the dissociation in the results between conceptual or perceptual self-awareness and mirrored or unmirrored self faces, but the novelty of these results warrants examination with different methodologies. In order to further support the idea that this phenomenon is due to one's mind state biasing the perception of the faces, in addition to the RT results, we should be able to find differences in the frequency of "self" responses in faces that are of ambiguous identity, rather than clearly self or other.

**Experiment 2 – Self vs. Other Discrimination with Ambiguous Faces**

In order to provide converging evidence for the RT results, we examined the frequency at which participants reported seeing their own face in a morph between themselves and a celebrity face, at varying degrees of interpolation.

*Participants:*

11 psychology undergraduates (2 male/9 female) participated in this experiment for partial fulfillment of course credit requirements. 7 participants were Caucasian, 3 were Asian, and 1 was Black. One male subject was excluded due to high error rates.

*Procedure:*

This procedure largely followed that of the previous experiment. However, instead of using natural self and other faces, we generated composite faces, interpolated between the participant's face and the face of a celebrity. The celebrity used was based on similarity to each participant's skin tone and matched for gender, chosen from either Brad Pitt, Angelina Jolie, Halle Berry, or Denzel Washington. The reason for using a celebrity face was to better equate for familiarity between the self and other faces, in order to ensure that we were measuring self-awareness rather than familiarity. The self and celebrity faces were grayscale, sized to 200 by 273 pixels, balanced for luminance and placed on a background of Gaussian noise. Using Avid's Elastic Reality morphing software, we then generated linear-warp morphs between the two faces. Using Bezier shapes based on 49 reference nodes for each face, we created a continuum of 20 frames between the self and celebrity faces (Figure 2-1). For half of the participants, we used their unmirrored face to create the morph, and for the other half of the participants, we used their mirror-reversed face. The celebrity face always remained unmirrored to control for familiarity.

Participants were tested in each of the 4 conceptual and perceptual, self and other instruction conditions outlined in the previous experiment, and condition order was matched between the mirrored and unmirrorred subjects. They were asked to determine, as indicated by button press, whether the face “looked more like them” or “more like the other person”, going with their “gut reaction” if they were uncertain. Again, they were asked to respond quickly, but more importantly, to do their best to maintain the instructed state of awareness while responding to the faces. The 20 interpolated faces were presented randomly, 4 times per condition, yielding 80 “self” or “other” responses per condition. Every 20 responses, the participant was given a brief refresher instruction, in case he became distracted while responding to the faces.

*Results:*

In order to determine if thinking conceptually or perceptually about themselves biased the participants’ perception of the ambiguous faces, we examined the frequency of “self” responses. We found the expected interaction between conceptual/perceptual self instruction type and mirrored/unmirrored self face, $F(1,8) = 8.01$, $p = .022$. Unmirrored participants reported seeing their own faces at a higher frequency in the conceptual self (abstract self-concept) instruction than in the perceptual self (attention to breathing) instruction, while mirrored participants showed no difference between the conceptual and perceptual self instructions (Figure 2-2). The interaction appears to be driven by the unmirrored participants, who were significantly more likely to see the faces as themselves when they were given the conceptual self instruction ($M = .45$, $SD = .09$), than when they were given the perceptual self instruction ($M = .40$, $SD = .09$), $t(4) = 3.34$, $p = .029$. In both the mirrored and unmirrored conditions, the range of ambiguity in the interpolated self-other faces was between 45% self and 70% self, with consistent categorization of less ambiguous faces.

*Discussion:*

The results from the morphed and natural face recognition experiments show that participants who are thinking about themselves from the perspective of others more readily recognize their own faces when they are as presented as other people would see them than when they are presented as they would see themselves from their own perspectives. This effect seems to be driven by participants being less able to recognize their own unmirrored faces when they are thinking about perceptual aspects of themselves. This lends support to the idea that conceptual information about oneself can over-ride perceptual self-information, at least in the domain of one's self image, and that focusing on one's self-percepts can inhibit the shift from perceptual to conceptual self-processing. These results extend naturally to the realm of performance, as there is currently a debate about the effects of social pressures, such as home-field advantage, on skilled motor performance. Using our conceptual and perceptual self-awareness manipulations, we can examine whether these performance effects can be replicated in a lab setting, and whether the effects are unique to conceptual and perceptual self-awareness.

## 3. SELF-AWARENESS AND PERFORMANCE

The Trier Social Stress Task is an experimental manipulation, in which subjects are placed in front of cameras, flood lights, and a two-way mirror, and asked to give a speech into a microphone, following a period of anticipation (Kirschbaum, Pirke, & Hellhammer, 1993). This is generally used to increase stress levels in subjects, but we speculate that it can be viewed as an extreme version of traditional self-awareness manipulations, in which the subject is unequivocally made the object of social scrutiny. Highly anxious public speakers have been shown to have more self-focused cognitions than non-anxious speakers (Daly, Vangelisti, & Lawrence, 1989). Subjects who are able to finish the Trier speaking task show significant changes in cognitive functioning, such as false memory for words with which they had not previously been presented (Payne, Nadel, Allen et al., 2002), and impaired free recall for emotionally-charged words (Kuhlmann, Piel, & Wolf, 2005). These are tasks with which people normally have much less difficulty, but the amalgamated conceptual self-awareness manipulation puts them in a state in which routine cognitions can become difficult.

While much research focuses on the effects of self-awareness on social behavior, the study of its effects on cognitive and motor performance is still in an early stage.
One very important finding is that even subjects with limited perceptual systems, cockroaches, are affected by the presence of other members of their own species. In maze tasks, when cockroaches are being “watched” by many other cockroaches, they tend to complete easy mazes significantly faster, but they are actually slower to run through more difficult mazes when an audience is present (Zajonc, Heingartner, & Herman, 1969). Self-awareness researchers use this study to highlight possible social facilitation and social loafing functions of SA, as well as socially-induced choking behavior.

With insect models, it is not easy to infer the qualia of the subject’s own experience in the maze task, so these experiments are extended to more complex organisms like humans. With humans, we see that self-awareness can be brought about in the absence of one’s peers, so local social pressures are not necessary to induce SA, though perceived social pressure (in which society continues to be represented conceptually in the mind of the performer) might be. In this way, self-awareness might enforce socially moral behavior, in the absence of a local social group. For example, when undergraduate subjects were given puzzles to complete, those subjects who performed the task while in front of a mirror and listening to their own recorded voice cheated significantly less than those who were not provided a reflection and who listened to someone else's recorded voice (Diener & Wallbom, 1976; Vallacher & Solodky, 1979). Since the two manipulations were treated as one self-awareness manipulation, participants may have cheated less in the "self aware" condition because hearing their own tape-recorded voice demonstrated the experimenters' capacity to surveil the participants' activities, but it is possible that the joint manipulation worked to induce self-awareness in a way that evoked and encouraged social standards of behavior.

Choking on skilled tasks in laboratory and field settings suggests that people are more likely to commit errors on skilled tasks when under evaluative pressure and other self-focusing conditions. Losing crucial basketball games appears to be more common under conditions of social pressure and self-doubt (Schlenker, Phillips, Boniecki et al., 1995).

Other research suggests that it might be explicit monitoring of the task itself that produces choking. In basketball, the free throw is a well-rehearsed task, in which a skilled player can succeed in the majority of cases, with elite teams like The University of Arizona successfully making 74.8 percent of free throw attempts in the 2000-2001 season (NCAA, 2001). However, this sort of highly proceduralized skill becomes difficult under conditions of explicit monitoring of task elements (Baumeister, 1995; Beilock, 2004; Beilock & Carr, 2001). To combat explicit task-focused attention, many players find it helpful to focus on perceptual aspects of the shot and visualizing the ball going through the basket. Other players find that engaging in ritualized behavior before each shot helps to engage their minds with the mundane, possibly acting to reduce explicit focus on the task (Gayton, Cielinski, Francis-Keniston et al., 1989; Poteet, 2000). The evidence for the efficacy of visualization and ritualized behavior as specific prescriptions for better free throw shooting is equivocal, but the accompanying reduction in focusing conceptually on the task may be what is most important, regardless of the method.

In Leary and colleagues' model of hypo-egoic awareness, focus on abstract properties of oneself should impair task performance, because it consumes resources that could be better allocated to concrete aspects of the task (Leary, Adams, & Tate, 2006). In order to overcome hypo-egoic awareness, one would try to direct focus away from oneself and towards present, unabstracted task demands. Therefore, the benefit of ritualized behavior or relinquishing explicit control should be derived from a reduction in conceptual self-awareness.

Beilock and Carr have found evidence to the contrary, using a miniature golf putting paradigm, in which self-awareness appears to buffer against the deleterious effects of explicit task-monitoring (Beilock & Carr, 2001). By placing a video camera in the room, and telling the subject that their actions are being recorded for later scrutiny, the researchers are priming the subjects to think about themselves as other people see them. This creates the conditions for conceptual self-awareness, which appears to help them perform better in high pressure situations than putters who are thinking about the task. Our question is whether this is a general effect of self-awareness, or if it is unique to conceptual awareness of the self. If this buffering does not occur when the subject is perceptually self-aware, this would suggest that the benefit is derived from a monopolization of conceptual resources that would otherwise be used to sabotage task performance, but not necessarily due to self-awareness.

## 4. EVIDENCE - Performance

### Experiment 3 - Self-Awareness and Skilled Motor Performance

In order to independently examine the effects of conceptual and perceptual, self and task awareness on skilled motor performance, we created a "penny golf" paradigm, in which participants were tested on how accurate they were in sliding a penny across a smooth table toward a marked target, while engaging in one of four guided attention tasks. Results by Beilock and colleagues (Beilock & Carr, 2001), led us to expect performance to be negatively affected by thinking explicitly about the task, and we predicted that this deleterious effect of task-awareness could be buffered by exhausting conceptual resources on a non-task subject of explicit awareness, or by engaging one's awareness with more perceptual elements of the task.

*Participants:*

48 psychology undergraduates participated in this experiment for partial fulfillment of course credit requirements.

*Procedure:*

Upon arriving at the lab, consenting participants were instructed on the rules of penny golf. They were told that the object of the game was to slide the penny from one side of the table toward a target on the other side of the table, at a distance of 42 inches. We placed a 30" x4" piece of transparent Plexiglas at the participant's end of the 30" x 60" table, elevated from the table's surface by a quarter inch, which allowed the penny to pass under the Plexiglas, but prevented the participant's hand from crossing this barrier in their attempts. Each participant practiced the task until they became accurate and consistent, as defined by the penny landing within 4 inches of the target on 3 of 4 consecutive attempts, with each participant completing a minimum of 40 practice attempts. They were then given a computerized instruction, including a quick reiteration of the rules of penny golf, followed by a guided attention task. They were then asked to practice maintaining the instructed state of awareness for one minute, after which they were given a brief refresher instruction and asked to slide the penny to the target. We recorded the distance of the penny from the target using a ceiling-mounted camera, after which the participants were instructed to pick up the penny and return to the computer for more instructions. The distance from the target was coded (in pixels) using Photoshop's measurement tool. For each instruction conditions, they were given three attempts to slide the penny, each preceded by a refresher instruction.

We used a mixed design in assigning participants to instruction conditions. Each participant completed either the conceptual self (abstract self image) and conceptual task (strategies for success in penny golf) instruction conditions or the perceptual self (breathing awareness) and perceptual task (sensory awareness of the experimental apparatus) instruction conditions, with every subject completing a "no instruction" control condition. Full text of the manipulations can be found in Appendix B.

*Results:*

There was a significant interaction between conceptual or perceptual and self or other conditions, in which self-focus led to better performance than other-focus when participants were attending to conceptual information, but worse performance when participants attended to perceptual information, $F(1,46) = 6.1$, $p=.017$, $N=48$ (Figure 3). Participants performed significantly better in the conceptual self-focused condition ($M = 76.37$, $SD = 27.87$) than in the conceptual task-focused condition ($M = 98.37$, $SD = 33.95$), $t(23) = 2.43$, $p = .02$, and the participants performed marginally better in the "no instruction" control condition ($M = 81.33$, $SD = 33.8$) than in the conceptual task-focus condition ($M = 98.37$, $SD = 33.95$), $t(23) = 1.74$, $p = .096$. We omitted trials in which the penny did not stay on the table from the analysis, because it was impossible to accurately record the distance from the target. This occurred in approximately five percent of all trials. When we assigned a distance of 215 pixels (the maximum distance recorded for trials in which the penny stayed on the table) to these trials, the interaction was virtually unchanged.

*Discussion:*

These results provide an indirect replication of Beilock's main mini-golf finding, in which focusing on how to successfully complete the task was detrimental to task performance. Supporting Leary's predictions, we find that thinking about perceptual elements of the task appears to facilitate better performance than thinking about higher-level goal states. We also find that asking participants to focus on their own abstract qualities appears to enhance performance. These findings run counter to Leary's predictions, in which thinking abstractly about oneself would lead to poorer task performance, because it consumes resources that should be dedicate to concrete task demands. However, this may be explained by Leary's treatment of abstract task demands as self-focus, while we treat it as other-focus. Additionally, our results may be specific to proceduralized tasks, or perhaps our practice session was long enough for subjects to become skilled at the task, but not necessarily long enough for the task to become "automatic".

If the conceptual self-awareness instruction had a protective effect on performance, then we need to determine if it is specific to self-awareness, or if the same performance gains could be achieved by conceptual attention to any non-task content. It may be that simply engaging one's conceptual faculties in any non-task-oriented abstract thinking can monopolize conceptual resources that might otherwise interfere with performance on the task. Our pilot data, in which participants were asked to think about positive and negative qualities of their best friends, rather than of themselves, suggest that the protective effect is unique to conceptual awareness of the self.

## 5. GENERAL DISCUSSION

The present results support a two-dimensional attention-based model (Figure 4), which can help us to think about self-awareness. The first dimension, self-focus, describes whether one is attending to the self or to non-self stimuli. The second dimension, level of abstraction, describes whether one's attention is tightly focused perceptual information in the present slice of space-time, or on conceptual information, diffusely distributed over the non-local past and future.

The model is incomplete in two ways. First, a two-variable model is likely an oversimplification of how self-awareness works, but a good first step would be to run more experiments based on the model's predictions, and then examine how much of the variance is explained by the model, adding additional variables as needed. Second, the model does not offer any predictions about the time course of the two variables, only that they oscillate continuously. These shifts in attention might be long and smooth, protecting conscious stability and cohesiveness, with gradual change suggesting hormonal modulators. It is also possible that optimal task performance is characterized by very frequent shifts between task and self-awareness checkpoints, or that quick shifts between high and low abstraction are necessary for current behavior to align with abstract goals. Leary suggests that these fluctuations may be very rapid, and that awareness is determined by the proportion of time that we spend on each pole of a given dimension, in the course of these fluctuations (Leary, Adams, & Tate, 2006). We speculate that optimal and pathological states may be determined by how freely one fluctuates between different poles on each dimension, with pathology characterized by becoming involuntarily "stuck" on one pole or another. Our prediction is that self-focus should naturally fluctuate more quickly than level of abstraction, since it is a matter of where one's attention is placed, while level of abstraction might vary as a function of how much information one is expected or attempting to accommodate, which may be cumulative over the course of a day. New research should examine the time course of these dimensions in states of rest and under task demands.

Various psychological diagnoses might be based on the patient's ability to regulate his or her level of abstraction and self-focus. Anxiety disorders are often thought to be marked by attention to abstract thoughts and pre-existing beliefs (conceptual), and one of the treatments for anxiety disorders is to identify irrational abstractions and to replace them with thoughts that are based more closely on reality (McDermott, 2004). There is evidence that people who focus more on perceptual information report very low anxiety levels, even when physiological arousal remains high (Bonanno & Singer, 1993; Weinberger, Schwartz, & Davidson, 1979), while socially anxious individuals who focus on public aspects of themselves under a camera manipulation show a more pronounced startle response (Davies, 2005; Panayiotou & Vrana, 1998). Depression is often accompanied by rumination over events past and dread of those in the future, though the content of these abstract thoughts need not be self-focused (Silvia, Eichstaedt, & Phillips, 2005). In extreme cases, suicide might offer the ultimate escape from this aversive state of abstract self-awareness (Baumeister, 1990). Assymetrical attention to a divergent conceptual framework at the expense of reality monitoring might even be involved in psychotic disorders. People with schizophrenia often show decrements in several visual attention paradigms, ranging from tests of basic visual functioning, such as motion perception, to top-down processes like figure-ground segregation (Braff, 1993; Malaspina, Simon, Goetz et al., 2004; Potts, O'Donnell, Hirayasu et al., 2002). The dorsolateral prefrontal cortex is likely involved in discriminating between information gleaned from external stimuli and information constructed by internal processes, and damage to this area can lead a person to miss changes in the real world and in the person's abstract construction of it (Knight, Grabowecky, & Scabini, 1995). We speculate that this is a case in which level of abstraction might be too low, because the affected person displays difficulty in interpolating between actual events to form a coherent narrative, suggesting that the ideal level of abstraction is one of balance between conceptual and perceptual, or a periodic oscillation between the two. An inability to conventionally filter and categorize environmental stimuli is also one of the proposed hallmarks of autism, and this impaired adoption of abstract social categories might explain the theory of mind deficits (termed "mindblindness") observed in many autistic patients (Baron-Cohen, 1995; Yirmiya, Erel, Shaked et al., 1998). Also, if they do not categorically differentiate themselves from their environment, then they should not be able to demonstrate an understanding of other people's minds, as abstract self-focus is correlated with increased perspective-taking (Stephenson & Wicklund, 1983). Interestingly, those autistic patients who do pass theory of mind tests are those with better verbal ability, a key tool for explicit abstraction (Happe, 1995; Pilowsky, Yirmiya, Arbelle et al., 2000).

These psychological diagnoses are paralleled by historical and modern religious explanations for maladaptive behavior, often invoking the concept of demons when speculating about non-local attention and pathological self-awareness. Perhaps the comfort of religion is that it provides answers to existential concerns about the past and future, allowing people to focus their resources on concrete information in the present. Independent of ideological interpretation, it seems that variations in level of abstraction can be beneficial, detrimental, or both, depending on the domain.

A helpful vignette in illustrating level of abstraction is that of the proverbial absent-minded professor. The professor's attention is necessarily almost exclusive to the abstract world of ideas, which might come at the cost of immediate perceptual processing, bringing about differences in time perception, spatial navigation, social interaction, and anything requiring attention to be focused on immediate perceptual cues. As countless day-planner quotations and posters with kittens proselytize, focusing too much on a future goal or lofty ideals can lead us to miss important markers along the journey; disproportionate weight on abstract processing, though necessary for modern survival, can blind us to real world stimuli. However, this story is one of balance, as attending to the past and future might also provide the driving force for motivated action in the present (Karinol, 1996; for a review).

Assumptions of automaticity are not inherent in this oscillatory two-dimensional model. Cultivating mindful awareness of these oscillations might help us learn how to control them, which could have profound benefits. By preventing one's mind from wandering into abstractions, we may augment our perceptual abilities. There is evidence that Zen meditators do not exhibit a typical EEG alpha suppression response, an attenuation of alpha brain waves when presented with repeated stimuli (Hirai, 1974; Kasamatsu & Hirai, 1966), though the reliability of this effect has been questioned (Becker & Shapiro, 1981). If the effect is reliable, it could be that this repetitive sound is never categorized as a distracter (in the way that we unconsciously filter out a rattling fan or ambient traffic noise), and is experienced perceptually for as long as it is presented. Similarly, meditators returning from a three month mindfulness retreat showed greater visual sensitivity than non-meditators, detecting shorter flashes of light stimuli and requiring a shorter inter-flash interval to successfully discriminate between flashes (Brown, Forte, & Dysart, 1984). Mindfulness and concentrative meditators have also been shown to perform better than controls in a task of sustained attention, with mindfulness leading to better gains than concentration when stimuli were unexpected (Valentine & Sweet, 1999). These studies suggest that meditation can aid a person in narrowing his or her temporal window of attention, making detection more acute and less dependent on prior stimuli. Indeed, many meditative techniques involve focusing on the here and now, either through controlled counting or attending to sensory perceptions like the feeling of one's breathing or heartbeat, and these techniques can be learned and refined with practice. An excellent phenomenological description of how meditation relates to level of abstraction and the self is given in the following excerpt from *Mindfulness in Plain English* (Gunaratana, 2002):

> Mindfulness is pre-symbolic… the reality which gives rise to words--the words that follow are simply pale shadows of reality…Mindfulness is nonconceptual awareness…It is not thinking. It does not get involved with thought or concepts. It does not get hung up on ideas or opinions or memories. It just looks. Mindfulness registers experiences, but it does not compare them. It does not label them or categorize them. It just observes everything as if it was occurring for the first time. It is not analysis which is based on reflection and memory. It is, rather, the direct and immediate experiencing of whatever is happening, without the medium of thought. It comes before thought in the perceptual process.
>
> Mindfulness is present time awareness. It takes place in the here and now. It is the observance of what is happening right now, in the present moment. It stays forever in the present, surging perpetually on the crest of the ongoing wave of passing time. If you are remembering your second-grade teacher, that is memory. When you then become aware that you are remembering your second-grade teacher, that is mindfulness. If you then conceptualize the process and say to yourself, "Oh, I am remembering", that is thinking.
>
> Mindfulness is non-egoistic alertness. It takes place without reference to self. With Mindfulness one sees all phenomena without references to concepts like 'me', 'my' or 'mine'. For example, suppose there is pain in your left leg. Ordinary consciousness would say, "I have a pain." Using Mindfulness, one would simply note the sensation as a sensation. One would not tack on that extra concept 'I'. Mindfulness stops one from adding anything to perception, or subtracting anything from it. One does not enhance anything. One does not emphasize anything. One just observes exactly what is there--without distortion. (pps. 137-148)

Since perception in humans relies on a narrow band of sensitivity to the full spectrum of real-world stimulation, we can never truly see the world "as it is", but we can maintain awareness of our "lower-level" percepts without abstracting away from them. This is probably what many meditative practitioners mean by mindfulness; the smallest reducible state of subjective perception.  The benefits of mindfulness may include increased compassion, increased positive affect, enhanced immunity, decreased anxiety, physical relaxation, increased vigilance, slowed age-related mental and physical decline, and better professional performance, in addition to learning how to regiment one's own consciousness to the degree necessary to achieve the mindful state (Alexander, Langer, Newman et al., 1989; Brown & Ryan, 2003; Davidson, Kabat-Zinn, Schumacher et al., 2003; Epstein, 1999; Stewart, 2004).

With new research suggesting that the human brain can generate new neurons throughout the life span (Eriksson, Perfilieva, Bjork-Eriksson et al., 1998; Paton & Nottebohm, 1984; van Praag, Schinder, Christie et al., 1999), there is renewed hope for anyone who wishes to change their own attentional tendencies and how they perceive the world.  If we can continue to identify and harness the relevant variables, in the future, people might not simply learn a set of rules for completing a novel task, but also an accompanying attention strategy for optimal performance. Such strategies might include abolishing or emphasizing the self, and willfully modulating how much we abstract from our basic percepts.

In future research, we can use our self-face recognition paradigm to assess state conceptual and perceptual self-awareness, and to develop more covert manipulations of self-awareness.  We would also like to extend our performance findings to non-proceduralized tasks, in order to determine whether the apparent protective effects of conceptual self-awareness are robust or specific to proceduralized motor tasks.  If people are indeed able to train themselves to control their state of awareness, then knowing the optimal state for various tasks could prove useful for people interested in performance enhancement through mindfulness training.

## 6. CONCLUSIONS / APPLICATIONS

To summarize, self-focus and level of abstraction interact to create different states of awareness. When a person is self-focused, low level of abstraction should make one aware of oneself as the perceiver, while high level of abstraction should lead to the awareness of oneself as the perceived. We suggest that perceptual and conceptual self-awareness affect one's internal self-image, as evidenced by the speed with which our participants recognized their own unmirrored faces while thinking about themselves from a social perspective, relative to thinking about perceptual aspects of themselves. Our performance studies suggest that conceptual self-awareness can help buffer against choking on well-learned tasks. However, this effect may be task-specific, with different states of self-awareness leading to differential effects on performance. We speculate that perceptual self-awareness might produce better performance in vigilance and change-detection tasks, while conceptual self-awareness might yield better results in tests of categorization and task-switching. By manipulating self focus and level of abstraction with targeted manipulations, we should be able to find optimal states in which performance on these tasks is augmented and sub-optimal states that are detrimental to performance.

These issues are particularly pertinent to education, when one considers policies regarding school uniforms, video surveillance, and what the model student "looks like". School uniforms are often lauded as the solution to the self-awareness problem in schools. If a student is focused on the socio-economic façade that is being presented to his peers through his clothing, he can not be focused on school-related tasks, and taking this worry away from the student should improve school performance. This is an intuitive conclusion, but the research on the effects of school uniforms on actual academic performance is inconclusive. It could be that the American culture of individualism trumps the homogenizing effect of school uniforms, and students find other self expression and status cues (such as hair or subtle uniform alterations) to occupy their attention. Despite the poverty of hard evidence, many teachers and administrators feel that school uniforms work to reduce discipline problems and increase academic achievement (Behling, 1994; Bodine, 2003), and this intervention is likely preferable to other more Orwellian measures, such as video surveillance. There is evidence suggesting that video cameras can be detrimental to intrinsic motivation if the intention of the surveillance is evaluative. Experimentally, when participants were told that they would be videotaped during a free-play session, intrinsic motivation (measured as the number of free-play events engaged in) decreased when subjects were told that the video feed was going to be used to evaluate their performance, though subjects who were told that they were being surveilled out of scientific curiosity or not surveilled at all performed no differently than when there was no camera present (Enzle & Anderson, 1993). If the intent of surveillance is to produce students who do not do anything, in an attempt to reduce the incidence of bad behavior, then this prevention-focused approach might work. If, however, we want intrinsically-motivated positive behavior to be preserved, then we might consider more targeted approaches (Gagnon & Leone, 2002), and relegate surveillance cameras to the penitentiaries.

Ideally, we can find strategies that improve performance while still providing students with a sense of autonomy that is conducive to intrinsic motivation. We might begin by asking what the ideal student looks like, and whether this stereotype is related to actual performance and the amount of knowledge and understanding that a student gleans from his or her education. Is the model student the teacher's pet who, with wide eyes and perfect posture, habitually sits in the front of class? Is it the student who slouches in the back of the classroom quietly and rarely participates? While many teachers would say that the former is the better student, because class participation makes them feel like more effective teachers, it may be that different levels of arousal are better for different students. The chronic doodler, for instance, might be engaging in this mundane activity to reduce her self-awareness or to achieve an optimal level of arousal, similar to the ritualized free-throw routine of a basketball player, allowing more information from the lesson to enter her awareness. Other behaviors, such as patterned finger tapping, might be implicit strategies for creating optimal arousal conditions for flow experience (Csikszentmihalyi, 1990). The hat-wearing sloucher might be introverted and have a lower threshold at which stimuli enter his awareness (Carr, 1971; Eysenck, 1989; Siddle, Morrish, White et al., 1969; Smith, 1968), leading him to seek lower levels of arousal in an attempt to dampen potentially distracting stimuli. The front-row pleaser might need the arousal provided by competition and posture in order for stimuli to breach her threshold of awareness. In a study of landmark recall using maps, elementary school students who were allowed to move around the classroom during the memorization phase remembered more landmarks than those who were confined to their desks, though this effect was not present for students from a non-traditional school who were accustomed to a more relaxed environment (Carson, Shih, & Langer, 2001). The presence of individual attentional differences suggests that we should be more concerned with objective measures of what a student has learned and less concerned with what they look like when they learn it, if our educational goal of the transmission of knowledge is primary to the goal of socialization and cultural homogenization.

Knowledge about optimal states of awareness can also help teachers to better tailor their lesson plans to human psychology. If it is found that certain types of performance (such as vigilance, hypothetically) are improved by perceptual self-awareness, while other types (such as task switching) are facilitated by conceptual self-awareness, then we speculate that an optimal lesson plan would encourage the flow state induced by perceptual self-awareness or non-self-awareness for the bulk of the lesson, punctuated by conceptual self-awareness when reorienting is necessary. Some tasks, such as mathematics, might be facilitated by an ability to think abstractly about multiple concepts, while tasks like cursive writing or art might benefit from augmented attention to perceptual features, such as shapes and intersecting angles. If it is the case that attention deficit is not a deficit at all, but rather an inappropriate displacement of attention, then therapies could focus more on training attention, rather than "increasing" it. Making lessons entertaining enough to compete with popular television and video games to breach the threshold for awareness could be supplemented by other strategies, such as meditation training to lessen internal noise and lower the threshold to a level that would allow less glamorous information to penetrate the student's consciousness (as suggested by Arnold, 1999; Holland, 2004).

Outside of the educational realm, we speculate that soldiers would benefit from a reduction in conceptual self-awareness, if it brought with it a reduction of anxiety and an increased capacity for vigilance, termed situational self-awareness. Presumably, anyone could benefit from learning the optimal conditions for attentional performance, and this research holds many applications in domains ranging from workplace efficiency to sports performance and personal realization. We can then examine how these states change within a person, as well as how attention "specialists" like artists and experienced meditators differ from the population at large. The inventive behavioral experimentation and rigorous physiological testing of our predecessors have paved the way for us to now examine questions about self-awareness that we can apply to our everyday lives, which could ultimately lead to improvements in the way that we observe and regiment our attention for the benefit of both self and society.

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## Appendix A

Full text of awareness manipulations used in the self-face recognition experiments.

*Perceptual Self*

In this condition, we need you to focus your attention on your breathing. Take a long, slow inhalation to the count of 5. 1,2,3,4,5. Now exhale to the count of 5. 1,2,3,4,5. Again, inhale. 1,2,3,4,5. And exhale. 1,2,3,4,5. Now allow yourself to breath normally and naturally as you continue to observe the location and feeling of your breath. Notice the points at which your breath begins and ends, and the feeling that you have as the air enters and leaves your body. All of your attention should be on your breathing, in the present moment. Continue to observe your breath for a few minutes. If your mind begins to wander, gently redirect it back to your breathing.

*Perceptual Self Refresher Instruction*

Again, watch your breath as you inhale to the count of 5. 1,2,3,4,5. Exhale to the count of 5. 1,2,3,4,5. Notice how you feel, and carry this awareness with you as you respond to the faces.

*Perceptual Other*

In this condition, we need you to focus you attention on your immediate environment. Take a moment to notice the brightness and quality of the lights in this room. Close your eyes. Listen carefully to the sounds that surround you, noticing the different layers of sound and their intensity. What does this room smell like? Feel if the room is hot or cold. Touch the keyboard. How does it feel? Touch the table and feel its texture. For a few minutes, continue to dedicate all of your attention to the perceptual qualities of your immediate environment. If your mind begins to wander, gently redirect it back to the qualities of your environment.

*Perceptual Other Refresher Instruction*

Again, turn your attention to your environment. Take a moment to notice how it feels, sounds, and smells. Carry this awareness of your environment with you as you respond to the faces.

*Conceptual Self*

In this condition, we need you to focus your attention on the things that you are good at. Think about these things. What things are you bad at? What makes you a good person? What motivates you? Who is the last person who you would ever let down? If you had to give a job interview right now, which qualities about yourself would you emphasize? Which weaknesses? Continue to think about your positive and negative qualities for a few minutes. If your mind begins to wander, gently redirect it back to thinking about these aspects of yourself.

*Conceptual Self Refresher Instruction*

Again, turn your attention to the qualities that define who you are as a person. Continue to think about these qualities as you respond to the faces.

*Conceptual Other*

In this condition, we need you to focus your attention on the factors that lead to successful performance on this face recognition task. What things are important to notice about the faces, in order to recognize them successfully? What would make this task harder? Easier? If you had to instruct another person on how to be successful in this task, what tips would you give them? Continue to think about this for a few minutes. If your mind begins to wander, gently redirect it back to the factors that lead to success on this face recognition task.

*Conceptual Other Refresher Instruction*

Again, turn your attention to the factors that lead to successful performance in this face recognition task. Continue to think about these factors as you respond to the faces.

**Appendix B**

Full text of awareness manipulations used in the penny golf experiments.

*Perceptual Self*

In this condition, we need you to focus your attention on your breathing. Take a long, slow inhalation to the count of 5. 1,2,3,4,5. Now exhale to the count of 5. 1,2,3,4,5. Again, inhale. 1,2,3,4,5. And exhale. 1,2,3,4,5. Now allow yourself to breath normally and naturally as you continue to observe the location and feeling of your breath. Notice the points at which it begins and ends, and the feeling that you have as the air enters and leaves your body. All of your attention should be on your breathing, in the present moment. Continue to observe your breath for a few minutes. If your mind begins to wander, gently redirect it back to your breathing.

*Perceptual Self Refresher Instruction*

Again, watch your breath as you inhale to the count of 5. 1,2,3,4,5. Exhale to the count of 5. 1,2,3,4,5. Notice how you feel, and carry this awareness with you as you place the penny on the table and slide it to your target.

*Perceptual Other*

In this condition, we need you to focus you attention on your immediate environment. Take a moment to notice the brightness and quality of the lights in this room. Close your eyes. Listen carefully to the sounds that surround you, noticing the different layers of sound and their intensity. What does this room smell like? Feel if the room is hot or cold. Now, holding a penny in your hand, feel its weight...it's size...it's texture. Touch the table and feel its texture. For a few minutes, continue to dedicate all of your attention to the perceptual qualities of your immediate environment. If your mind begins to wander, gently redirect it back to the qualities of your environment.

*Perceptual Other Refresher Instruction*

Again, turn your attention to the penny in your hand. Take a moment to notice how it feels. Carry this awareness of your environment with you as you place the penny on the table and slide it to your target.

*Conceptual Self*

In this condition, we need you to focus your attention on the things that you are good at. Think about these things. What things are you bad at? What makes you a good person? What motivates you? Who is the last person who you would ever let down? If you had to give a job interview right now, which qualities about yourself would you emphasize? Which weaknesses? Continue to think about your positive and negative qualities for a few minutes. If your mind begins to wander, gently redirect it back to thinking about these aspects of yourself.

*Conceptual Self Refresher Instruction*

Again, turn your attention to the qualities that define who you are as a person. Continue to think about these qualities as you place the penny on the table and slide it to your target.

*Conceptual Other*

In this condition, we need you to focus your attention on the factors that lead to successful performance on this penny golf task. What things are important to remember to get the penny to the target? What would make this task harder? Easier? If you had to instruct another person on how to be successful in this task, what tips would you give them? Continue to think about this for a few minutes. If your mind begins to wander, gently redirect it back to the factors that lead to success on this penny golf task.

*Conceptual Other Refresher Instruction*

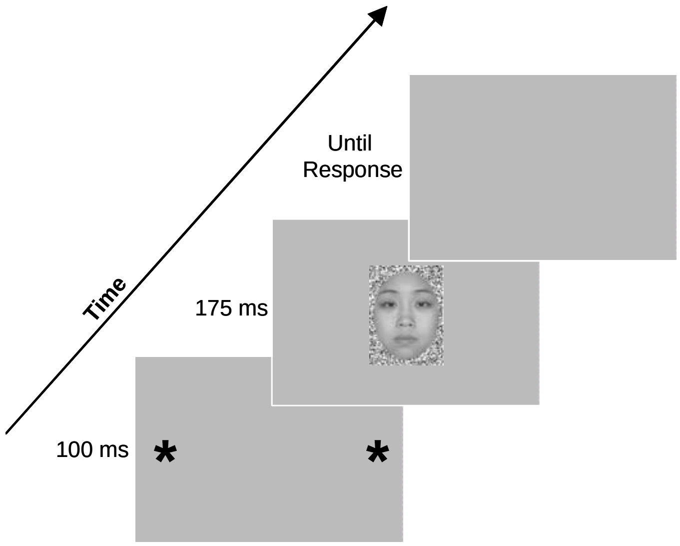
Again, turn your attention to the factors that lead to successful performance in penny golf. Continue to think about these factors as you place the penny on the table and slide it to your target.

*"No Instruction"*

Please place the penny on the table and slide it to the target.

# FIGURES

**Figure 1-1**
Each trial consisted of peripherally-presented asterisks to diffuse spatial attention, followed by either a self (mirrored or unmirrored) or other face. Ps were then asked to indicate if the face was "me" or "not me".



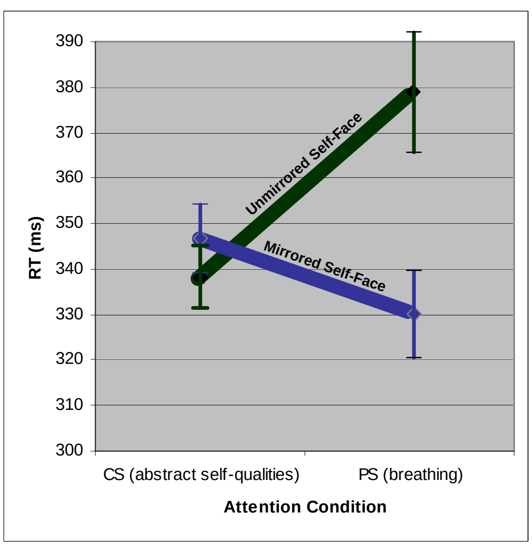
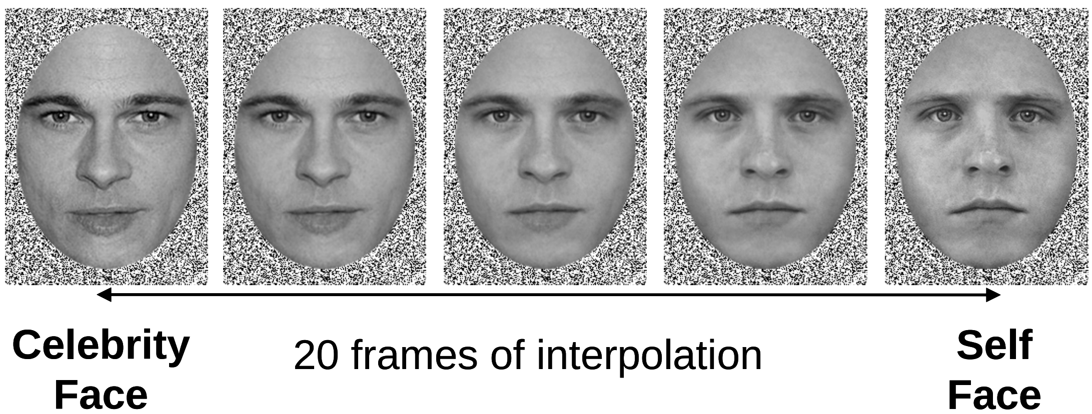




**Figure 1-2**
**Recognition of Natural Self-Face**
Ps were faster to recognize their own unmirrored faces when they focused on their abstract self-qualities than when they focused on their breathing, but they showed the opposite effect in recognizing their own mirrored faces, $F(1,23) = 8.26$, $p = .009$ for the interaction. Error bars represent the standard error of the mean, after controlling for differences in each subject's baseline RT. Data table below.

| | **CS (abstract self)** | **PS (breathing)** | **CO (task strategies)** | **PO (perceptual aspects of room)** |
|---|---|---|---|---|
| **Mirrored Face** | 347 | 331 | 326 | 354 |
| **Unmirrored Face** | 338 | 378 | 316 | 369 |

**Reaction Time (ms)**

**Figure 2-1**
**Self-Celebrity Face Morphs**
Each participant's mirrored or unmirrored face was paired with a celebrity face, balanced for luminance and skin-tone, and placed on a background of Gaussian noise. After matching key reference points between the two faces, they were linearly warped to create 20 individual faces at varying degrees of interpolation between self and celebrity.



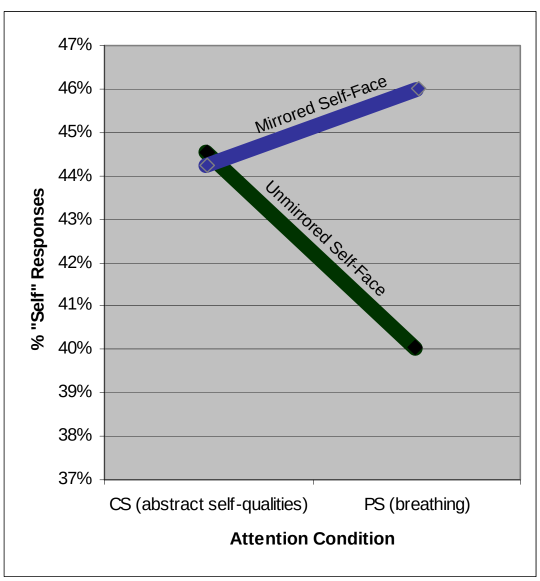




**Figure 2-2**
**Morphed Face Self-Recognition**
Ps whose mirrored faces were morphed with the celebrity face were more likely to see the face as themselves when instructed to attend to their breathing, while unmirrored Ps were more likely to see the face as themselves when attending to their abstract self-qualities, $F(1,8) = 8.01$, $p = .022$ for the interaction. Data table below.

| | **CS (abstract self)** | **PS (breathing)** | **CO (task strategies)** | **PO (perceptual aspects of room)** |
|---|---|---|---|---|
| **Mirrored Face** | 44.3 | 46 | 42 | 42 |
| **Unmirrored Face** | 44.5 | 40 | 42.7 | 43.3 |

**Percent "self" responses**

**Figure 3**
**Penny Golf Performance Results**
In the penny golf task, Ps performed worse when thinking about conceptual elements of the task than they did when thinking about perceptual qualities of the task, while they performed better when thinking about conceptual qualities of themselves than when thinking about perceptual qualities of themselves, F(1,46) = 6.1, p=.017 for the interaction.

| **CS (abstract self)** | **PS (breathing)** | **CO (task strategies)** | **PO (perceptual aspects of experiment)** |
|---|---|---|---|
| 74.3 | 90.4 | 98.8 | 80.5 |

**Distance from target (pixels)**

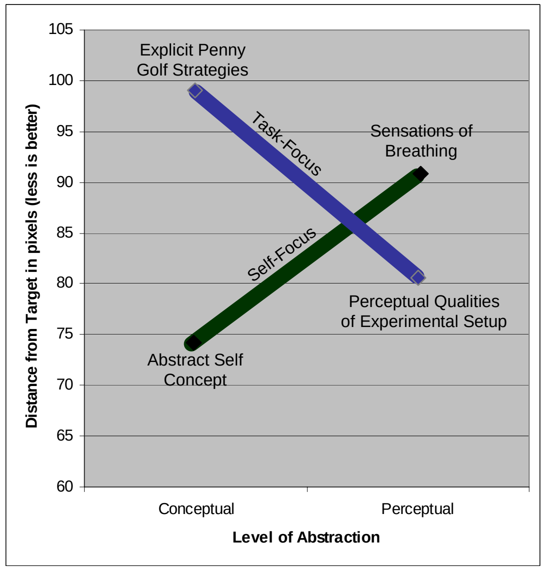



**Figure 4 –** An illustration of how level of abstraction (red) and self-focus (blue) might interact to produce different states of awareness, including conceptual and perceptual self-awareness. We hypothesize that the normal oscillations of the two variables coincide to produce different states and that unintentional disruptions in these oscillations could lead to pathology, while intentional control of these oscillations could produce optimal experience.