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Research Article

Air Metabolite Preclusion Reduces Conscious Thought

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Abstract

Five studies supported the hypothesis that preclusion of air metabolite availability reduces conscious thought. Participants reported having fewer thoughts while having breathed through a bag without, rather than with, a hole at its end (Study 1). Participants who held their breath for 10 seconds reported having had fewer conscious thoughts than did participants who breathed normally (Study 2). Consistent with economic theories of resource scarcity increasing value, ratings of importance for a potpourri of items increased among participants who held their breath while rating those items, relative to ratings made by participants who breathed normally (Study 3), an effect that is mediated partly by effort expenditure, as suggested by self-reports of hiccup riddance (Study 4). Self-reported hunger correlated positively with ratings of importance of thought content (Study 5), raising plausibility of metabolite resource availability as an explanatory mechanism.

Keywords: consciousness, decision making, respiration

Introduction

Views that incorporate ideas about energy may be useful. Psychological processes occur via the use of glucose from food and oxygen from air. The current work extends theory on oxygen by testing whether preclusion of breath decreases the number of conscious thoughts that people have. Air is needed for conscious thought, and so lacking air therefore should reduce conscious thought. One purpose of the work is to demonstrate how conscious process performance is sensitive to brain energy metabolite provision.

Four lines of evidence provide rationale for the hypothesis. Conscious processes tend to be resource consuming and effortful (Bargh, 1994), and therefore reduced air resource might reduce conscious processes. Increased oxygen intake has been found to benefit (Moss, Scholey, & Wesnes, 1998), and decreased intake to harm (Terry, 2001), conscious processes. Oxygen intake is reduced during sleep, and conscious

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processes terminate. With extreme air deprivation, conscious thought terminates.

Sailors who were confined in a hypobaric chamber, in which they were exposed to varying oxygen levels, for fifteen days, completed cognitive tasks (Shukitt, Burse, Banderet, Knight, & Cymerman, 1988). Performance generally was impaired at the lowest oxygen levels. Participants performed more poorly at 10,000 than 14,000 feet on a divided attention task (Terry, 2001). Volunteers exhibited impaired performance on cognitive tasks at simulated higher altitudes (Crowley et al., 1992; Gerard, 2000). Giving the volunteers supplementary oxygen eliminated these impairments. A few studies found that providing supplementary oxygen improved performance on memory, attentional vigilance, and intelligence tasks (Edwards & Hart 1974; Moss & Scholey 1996; Neubauer, Gottlieb, & Pevsner, 1994; Winder & Borrill, 1998). Participants who breathed 100% oxygen for 1 minute, compared to participants who breathed room air, performed better on word recall and attention-vigilance tasks (Moss et al., 1998).

Counterarguments to the hypothesis exist, though they are without empirical support. Conscious thought might increase during times of precluded breath to facilitate regaining breath and taking necessary action. Conscious thoughts may arise automatically and be insensitive to fluctuations in available energy during breathholding. To the extent that conscious processes use a large amount of energy, they may be insensitive to minor fluctuations.

Experiment 1

Forty-eight participants breathed through, in counterbalanced order, two paper bags – one with a hole at its end and one without – for 20 seconds. They were instructed to count the number of thoughts they had while breathing through each bag.

Participants reported having had fewer thoughts when breathing through the bag without a hole ($M = 7.02$, $SD = 5.31$) than with a hole ($M = 8.45$, $SD = 7.71$), $F(1, 47) = 4.76$, $p = .03$. Counterbalancing condition and its interaction with bag condition were non-significant, $ps > .81$.

Breathing through the paper bag without a hole at its end likely decreased the amount of oxygen inhaled (Gorman et al., 1984), suggesting that participants had fewer conscious thoughts because they had less oxygen. That participants inhaled more carbon dioxide while breathing through the bag without a hole, or that the thought counting process was biased, may account for the findings.

Experiment 2

Forty participants were randomly assigned to either hold their breath or breathe normally for 10 seconds. They then reported the number of thoughts they had during the breathing manipulation. Participants who held their breath reported having had fewer conscious thoughts ($M = 1.53$, $SD = 1.54$) than did participants who breathed normally ($M = 4.14$, $SD = 6.24$), $t(38) = 1.88$, $p = .04$.

Whereas the design of the second study counters the explanations (based on carbon dioxide and thought counting) for the results of the first one, its limitations include plausiblility of errors in recall relating to breathholding. It is plausible that participant were biased in their perception of what effect the manipulation may have had. To develop explanation for the influence of breatholding on conscious thought, the third study is based on economic-resource theory.

Experiment 3

Reductions in supply increase value. If breatholding decreases conscious thought, then the content of conscious thought should increase in value when people hold their breath.

Method

Participants. The researcher approached individuals in frequented public areas with

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invite to complete a questionnaire activity. Forty-one individuals who agreed to participate constituted the final sample.

Procedure. The author developed a questionnaire in English that was subsequently translated into Turkish. The questionnaire included 10 items that varied in importance (in order of presentation - a loaf of bread, a speck of dirt, human life, the life of a cat, the life of a fly, a frying pan, pigeon poop, the appendix, the heart, water) and instructions to rate each item on the extent of its importance, using a 7-point scale (1 - not at all important, 4 - somewhat important, 7 - very important), making response on a line preceding each item. Instructions indicated to either hold one's breath while completing the questionnaire or to breathe normally.

Results and Discussion

Participants who held their breath rated the items (M = 5.22, SD = 1.55) as more important than did participants who breathed normally (M = 4.80, SD = .75), t(39) = 1.65, p = .05. The effect of condition did not vary by item or item order.

Experiment 4

The fourth study provides presentation of two forms of indirect evidence that breatholding reduces conscious thought. People often hold their breath to rid themselves of the hiccups. On this basis, it was predicted that people who use this technique over others would rate the hiccups as being more important, suggesting accompanying reductions in thought. Providing additional test, particpants had indicated the extent to which they had used effort to rid themselves of the hiccups. Because both effort and thought rely on metabolites as common resource (Fairclough & Houston, 2004), mediation of increased import from breathholding by effort expenditure suggests reductions in thought. People expend effort and hold breath for hiccup riddance, metabolite resource is reduced, thought number decreases, and thought import (of hiccups) increases.

Method, Results and Discussion

Thirty-nine participants responded to questions about the hiccups. They were asked to indicate what they typically do when they have the hiccups and the extent to which they viewed getting rid of the hiccups as important.

Participants who reported typically holding their breath as a technique to rid themselves of the hiccups; rated the hiccups as being more important (M = 5.33, SD = 1.75) than did participants who reported typically doing nothing to rid themselves of the hiccups (M = 2.67, SD = 1.61), F (1, 38) = 17.70, p = .00. This difference was mediated by the extent to which participants indicated having used effort to get rid of the hiccups, such that participants who reported using the breatholding technique indicated having expended more effort.

Experiment 5

If changes in metabolite resource explain increases in thought import, then changes in metabolite supply akin to breatholding should increase thought import. The researcher approached individuals in frequented public areas in Turkey and at a university with invite to complete a questionnaire. Ninety-one individuals who agreed to participate constituted the final sample.

The survey contained three questions, appearing in both English and Turkish: 1) How hungry are you?, 2) What are you thinking about?, and 3) How important is that which you are thinking about?. Responses to items 1 and 3 were made by circling a response on a 7-point scale (1 - not at all, 7 - very). Responses to item 2 were open-ended. Item 1 and items 2 and 3 were counterbalanced across participants.

Results and Discussion

Ratings of hunger correlated significantly and positively with ratings of thought importance,
$r(89) = .26$, $p < .05$. The strength of the correlation between hunger and thought importance differed nonsignificantly between counterbalancing conditions, $z = .78$, ns, and between participants who either did or did not report thinking about food, $z = 1.07$, ns. The latter suggests that the relationship between hunger and thought importance was not attributable to hungry participants thinking about eating.

General Discussion

The results from five studies of different methodological design provide convergent support for the hypothesis that preclusion of air metabolite reduces conscious thought. Breathing through a paper bag (Study 1) and breatholding (Study 2) reduced the number of conscious thoughts. Breatholding associated with increased thought import (Studies 3 and 4), suggesting reduced thought occurrence, as interpreted from economic-resource theory. Findings on effort expenditure (Study 4) and hunger (Study 5) raise plausibility of metabolism as an explanatory factor. Conscious thought may occur in correspondence with air provision.

The rubric may explain many social phenomena, including sighs, choking, and the phrases, “You take my breath away” and “Don’t hold your breath”. The child holds breath, reducing air intake, until red in the face, to signal the importance of desire for a candy bar. A ‘hmmph!’ declares the import of being wronged socially by blowing out air. The punch to head - and accompanying halting of typical breath - aggrandizes thought of retaliation within the boxer. ‘Take heed, my importance!’, the perpetrator screams metaphorically at mind of stabbed victim, blood pooling on ground. In each example, reduced resource availability strengthens perception of importance.

The findings lend themselves to the development of a general resource theory of psychological importance. When resources for process are of want and process occurs, that which is processed is perceived as being more important. When air for psychological thought is of want, and thought occurs, that which is thought about is perceived as being more important. The strongest theoretical support may be derived from an understanding of extreme resource want, such as during breath deprivation and starvation. Upon starvation or preclusion of breath, attention likely would orient immediately and continuously toward obtainment of food or air - definitively important thought.

That want of resource increases importance of contingents may explain emotion or affect. Stifled breathing during anxiety may augment perceived importance of anxiety-evoking thought or threat. Rumination may occur among the sad because lack of energy incurs import to depleting or low energy cognition. Low glucose and other energy-limiting metabolic factors might increase aggression (Gailliot & Baumeister, 2007) by highlighting focal, aggression-consistent thought. Thoughts of food and weight may bombard in psychological importance among people experiencing anorexia or bulimia (e.g., after purging), thereby promoting continued disorder. Cigarettes may increase in importance due to holding one’s breath while smoking. The businessperson may more capably shift importance among the hungered client on mountaintop (lower oxygen) than among the well-fed at sea level.

Drinking alcohol reduced glucose in both the bloodstream (Kokavec & Crowe, 2003) and brain (Zhu, Volkow, Ma, Fowler, & Wang, 2004), which suggests a mechanism through which salient environmental or internal stimuli become importantly myopic (Steele & Josephs, 1990). Using self-control depletes self-control resource (Muraven & Baumeister, 2000), or glucose (Gailliot, Baumeister, et al., 2007), potentially signaling the importance of engaged in self-regulatory process, consistent with larger

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decreases in blood-glucose during the Stroop task having predicted larger increases in learning (Gailliot, 2012). People learn that which they perceive as important.

The current work has its limitations. The theory on want and importance may be less applicable to nonconscious or automatic judgments because they may require less energetic resource. Greater specificity may be achieved by delineating the precise resource (e.g., whole brain glucose metabolism or neuronal want). Though some thoughts may arise automatically and without effort, others do not, and these thoughts may be most likely to be reduced with want of breath. One strength of the work, however, is that it used novel methods for manipulating air supply.

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