"Know-How, procedural knowledge, and choking under pressure"

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Abstract I examine two explanatory models of choking: the representationalist model and the anti-representationalist model. The representationalist model is based largely on Anderson's ACT model of procedural knowledge and is developed by Masters, Beilock and Carr. The antirepresentationalist model is based on dynamical models of cognition and embodied action and is developed by Dreyfus who employs an antirepresentational view of know-how. I identify the models' similarities and differences. I then suggest that Dreyfus is wrong to believe representational activity requires reflection and attention. I also argue that the representationalist model of choking is preferable, since some embodied actions require appeals to representations, something not available to Dreyfus's anti-representational model.

Keywords Know-How · Procedural knowledge · Dreyfus · Beilock · Choking under pressure · Representation

1 Introduction

Choking under pressure, or the choking effect, occurs when perceived stress or pressure results in the suboptimal performance of an action or task that under standard conditions is performed at a higher skill level or with greater success. The effect of the perceived stress or pressure is that the agent, athlete, or expert 'chokes', or performs below the expected level of skill (Baumeister 1984; Beilock and Carr 2001; Beilock 2010; Lewis and Linder 1997; Mesagno et al. 2009). Recent work in the psychology of sport and expertise strongly suggests the mechanisms of attentional focus elicited by stressful or pressure situations tend to interrupt or degrade the skillful performance. On one influential model it is argued that the attentional mechanisms involved in choking are thought to interrupt encoded procedural mental and motor skills that run automatically without awareness, introspection or attention (Beilock and Carr 2001). Attention, however, is not necessarily the boogeyman some might consider it. Attentional focus

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on the external effects a movement or action has on the environment can have a positive impact on performance and learning (Wulf 2007).

While research on choking under pressure has grown in recent years (Beilock and Gray 2007; see Christensen, Sutton, Mcllwain Ms. in this volume for a critical review; Hill et al. 2010), little attention has been devoted to the philosophical assumptions underlying different models of choking. Diagnosing the choking effect requires psychologists and philosophers to invoke philosophical claims about the role knowledge plays in the execution of bodily skills and expertise and how the knowledge is represented and encoded, if it is at all. I argue for drawing a distinction between models of choking that cuts the terrain differently than how it is typically cut. In doing so, I aim to identify the philosophical assumptions underlying certain models of choking. Understanding of the underlying philosophical claims of each model should affect research on the validity of the models and how choking can be mitigated, since if the underlying assumptions about knowledge prove untenable then that will bear on the tenability of the proposed choking mechanism.

It is standard to distinguish two explanatory models of choking, distraction theories and explicit-monitoring, also known as self-focus theories (Beilock and Carr 2001; Hill et al. 2010). Distraction theories claim that pressure situations "shift attentional focus to task-irrelevant cues, such as worries about the situation and its consequences" (Beilock and Carr 2001: 701). The processing efficiency theory, one type of distraction theory, claims that worries tax working memory resources for efficient skill execution and thus incite "on-task effort" that is meant to "compensate for reduced performance effectiveness" (Wilson et al. 2007). Explicit monitoring theories claim that pressure situations increase self-consciousness and induce anxiety about the performance, thereby shifting attentional focus to the steps required for performing the task (Beilock and Carr 2001; Beilock et al. 2002). Both of these theories make important claims about knowledge in action. Explicit monitoring theories suggest pressure interrupts skill-based knowledge that is proceduralized and thus outside working memory, while distraction theories tend to identify working memory as the locus of task-relevant knowledge. According to distraction theories, when working memory must compete with task-irrelevant cues for attention, subjects are distracted from attending to the task at hand and efficiently exercising their task-relevant knowledge. The debate between distraction theories and explicit-monitoring theories is certainly ongoing. In a recent literature review Hill et al. suggests that while explicit monitoring or self-focus theories face some methodological concerns, "the extant choking literature offers self-focus as the most plausible mechanism of choking in sport; although distraction evidently has an impact" (2010: 30). One common feature both theories exhibit is a commitment to a cognitivist view of knowledge in action, and thus to a representational model of choking, a commitment that stands in contrast to the most important philosophical model of choking articulated in the work of Hubert Dreyfus.

With Dreyfus's work in mind we can cut the terrain differently by distinguishing two models of choking, what I will call the representationalist model (Beilock and Carr 2001; Gray 2004; Masters 1992; Masters and Maxwell 2008) and the anti-representationalist model (Dreyfus 2005). Although distraction theories and self-focus theories are competing models, I will limit my discussion to the latter, since, as will become apparent, they more closely resemble Dreyfus's model of choking. What distinguishes representational and anti-representational models is not only the role

representations play in the explanation of why agents choke, but how each generally understands "the cognitive structure supporting performance and differences in performance itself" (Beilock et al. 2002). While the nature of each model and their views about knowledge will become clearer below, it is helpful first to outline generally each model. First, both models aim to explain why agents choke by identifying some mechanism. Second, both models identify self-monitoring, self-consciousness, and attention to rules or skill execution as contributing to choking. Third, both models suggest that there is a qualitative shift in the cognitive structure underwriting skilled performance as a subject progresses through the stages of skill acquisition. It is at this point that the two models begin to part ways. Representationalists tend to view skill acquisition as consisting in a set of stages; during the first stage a set of heuristics, rules, or "control structures" that are stored in working memory and attended to by the subject are exploited to perform an action (Anderson 1982; Beilock et al. 2002; Fits and Posner 1967). The control structure offers step-by-step instructions or heuristics that are represented just prior to acting or in the action itself. Representationalists believe the control structures become proceduralized, in which case the knowledge structures are encoded in a way that no longer requires attention and control for the knowledge structures to inform the skillful performance. On the representationalist view, embodied coping is in part representational and unreflective. Dreyfus, the leading proponent of the anti-representational model of choking, recognizes that in the earliest stages of skill acquisition subjects tend to proceed with the help of "information processing" represented heuristics he calls "context-free" rules (Dreyfus 1986: 21). However, in his model, during later stages of skill development, and particularly the final stage of expertise, these representational control structures completely drop out and no longer operate to inform the subject's skilled action, much like how training wheels are removed once a cyclist has learned to ride a bicycle (Dreyfus 1986: 22; 2002b: 416). Once the heuristics drop out they are presumably absent from working memory and are not implemented representationally. On Dreyfus's view, embodied coping is non-representational and unreflective. The important difference between each model is the extent to which they posit that skillful and unreflective action requires representational and cognitive control structures. The representational model of choking takes representational control structures to be central to its account of choking, while the anti-representationalist claims that skillful, unreflective action operates without such representational control structures.

In recent years Dreyfus has argued that theories of action that appeal to conceptual understanding, conceptual activity or representational activity are incapable of articulating a theory of unreflective, automatic or embodied action because a subject's conceptual or representational activity interrupts the action's successful performance or diminishes its quality (1986, 2005, 2013). A target for Dreyfus is intellectualist and representational theories of know-how that he takes to underwrite some proposed views of unreflective action (Dreyfus 1986; 2005; McDowell 1994). Dreyfus's argumentative strategy is to appeal to the phenomenological insights of Heidegger (Dreyfus 1991), Merleau-Ponty (Dreyfus 2002a), findings on choking (Dreyfus and Dreyfus 1986), considerations of speed (Dreyfus 2002a: 272; 2005) and dynamical systems theory (Dreyfus 2002a) to argue that know-how is not representational, and thus not propositional, conceptual or generally rational (Dreyfus 2007a: 360). Dreyfus even concludes that expert know-how does not require self-conscious awareness and is even

diminished by it. Recently, philosophers have critically engaged Dreyfus's account of self-consciousness (Zahavi 2013) [1], appeals to phenomenology (Colombo 2013; Gottlieb 2011), speed (Gottlieb 2011), and rationality (Schear 2011), yet his model of the choking effect has largely remained intact. While some critiques have questioned Dreyfus's insistence that expert absorbed coping is mindless (Montero 2010; Sutton et al. 2011), his reliance on an anti-representational model of embodied action or absorbed coping remains unchallenged. It is important to examine this aspect of Dreyfus's model of choking since, as I argue, it distinguishes his model from those found throughout the psychology and sport studies literature.

While my central concern is to identify how these models differ, I will also examine which model currently possess more explanatorily power. I will suggest there is some reason to think that Dreyfus's anti-representationalism currently lacks in explanatory power when compared to current representational models. His explanation of the choking effect is that agents switch from a non-propositional and non-representational control structure (know-how) to a propositional, and thus, representational control structure (know-that). Representational structures, Dreyfus assumes, require reflection and self-focused attention, cognitive activities that interrupt fluid bodily action. Therefore, agents choke when representational activities inform embodied coping. Dreyfus's assumption that representation requires reflection is questionable, particularly since there is good reason to view representations, rules, and concepts as informing perception and action independent of any explicit inferential or reflective activity (Gottlieb 2011). Philosophers and neuroscientists who hold that there are conceptual representations involved in perception (McDowell 1994; Sellars 1997) or motor representations in motor skills (Clarke 2010; Jeannerod 1997) disavow the view that these representations require reflection to be activated. One might think that research on choking supports Dreyfus's anti-representationalist views of expert action, but I will argue that such findings in sport psychology are incompatible with Dreyfus's explanation of choking.

Dreyfus's novel account of choking is important since, when its philosophical claims about knowledge are clarified, it offers an alternative to the models developed by many psychologists. In contrast to the work of some sport psychologists, it is important to note that his analysis of choking bears less on how one might alleviate choking and more on overcoming the classic mind-body problem or what he calls the Myth of the Mental (Dreyfus 2005). His work, however, is not unconnected to the work of sport psychologists since Dreyfus's views challenge, as I show, the very paradigm according to which sport psychologists formulate their models of choking. For this reason, Dreyfus's model and my comparative analysis of representationalist and anti-representationalist models of choking should be relevant to psychologists, in addition to philosophers, since, if his model of choking is correct, many of the philosophical claims psychologists and philosophers make about knowledge in action are false.

My analysis and argument proceed as follows. In the first section, I introduce two forms of practical knowledge discussed by psychologists and philosophers when diagnosing the choking effect: know-how and procedural knowledge. With each form of practical knowledge there is a philosophical debate about how the knowledge should

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[1] In addition to Zahavi's essay, see James Dow's unpublished manuscript "Just Doing What I Do: Expert Bodily Action, Self-Consciousness and the Awareness of Agency".

be characterized, and in this section I examine the nature and philosophical implications of each debate. In the case of know-how, the debate concerns whether or not know-how is a species of know-that. Is know-how a propositional state that is reducible to know-that representational states or is a disposition or ability lacking any content? The debate about procedural knowledge concerns how knowledge is represented in intelligent systems. With procedural knowledge the question of debate is whether or not knowledge is represented procedurally, declaratively, or through some combination. The two debates concern the nature or role of representations in cognition and action, and for this reason are relevant to explaining the choking effect. In the second section, I will show that the analysis of the choking in sport psychology requires an appeal to the representational features of practical knowledge, and primarily, the representational features of procedural knowledge. In the third section, I turn to Dreyfus's anti-representational model of absorbed coping and the choking effect, in which he claims know-that interrupts the flow of expert know-how. While he describes the choking effect by appealing to know-how, I will suggest that a better model for capturing his intended claim is the procedural-declarative distinction. In the fourth section, I will argue that Dreyfus faces a dilemma of sorts: his commitment to anti-representationalism about absorbed coping conflicts with the well-researched and empirically informed accounts of why agents and athletes choke, accounts which require explanatory appeals to representations in embodied action. I will suggest that Dreyfus does not provide good reasons to question representationalism, especially since there are promising models of embodied skillful knowledge that require appeals to embodied representations.

When debating the import of representations in cognitive science it is not uncommon to find representationalist and anti-representationalist at an impasse. The purpose of this paper is not to propose a model of representations, but to critically examine two distinct models of explanation, the representational model of choking the anti-representational model of choking. It will be useful to keep in mind a fairly standard model of representations (Haugeland 1998): representations are items of a system that "stand in for" features relevant to the system's behavior that are not always present or available to the system. The representations, in the absence of some relevant feature, guide or inform the behavior of the system. While classical theories of representations consider them context insensitive, disembodied, and atemporal, there is no reason to persist with such dogmatic claims, since alternatives are available (Prinz and Barsalou 2000). Dreyfus's anti-representationalism is partly grounded in a classical view of representations (Clark 2002; Colombo 2013) that assumes a dynamical model of the brain does not require explanatory appeals to representations (Dreyfus 2002a), since representations are context insensitive. Dreyfus finds much empirical support in Walter Freeman's dismissal of representations (Freeman 1991). However, Tim van Gelder, a leading proponent of dynamical models of cognition (van Gelder 1995, 1998), unlike some more radical proponents (Chemero 2000, 2009), recognizes, by abductive reasoning, that dynamical models "allow plenty of room for representation" (Port and van Gelder 1995: 12). As he acknowledges "A useful criterion of representation—a reliable way of telling whether a system contains them or not—is to ask whether there is any explanatory utility in describing the system in representational terms. If you really can make substantially more sense of how a system works by concretely describing various identifiable parts or aspects of it as representations in the above sense, that is the best evidence you could have that the system really does contain representations"

(van Gelder 1995: 352). Following van Gelder's abductive suggestion, I will argue that proponents of representationalist models of the choking effect are right to invoke representations for explanatory reasons in their accounts of choking and unreflective action.

2 Two kinds of practical knowledge

There are two kinds of practical knowledge relevant to understanding the choking effect: know-how, which is central to Dreyfus's model of choking, and procedural knowledge, which is central to representationalists like Masters, Beilock, and Carr. I call them practical not to suggest that they lack a theoretical dimension, but only to highlight that each form of knowledge primarily contributes to action, whether a bodily or mental action.

2.1 Know-How

The debate over the nature of know-how takes its bearings from Gilbert Ryle's The Concept of Mind (1949). Ryle defends the view that knowledge-how to do something (knowing how to ride a bicycle) cannot be reduced to or derived from the propositional knowledge-that something is the case (knowing that one must peddle). Know-that is a truth-evaluable state of knowledge with a propositional content that represents some fact of the matter. If a state of know-how is a species of know-that, it must also be propositional and representational. Since know-how cannot be propositional, as Ryle contends, it cannot be a species of know-that.

The purpose of Ryle's argument for the distinction is to challenge what he calls the "intellectualist legend": the view that "a performance of any sort inherits all its title to intelligence from some anterior internal operation of planning what to do", where the planning involves considering a proposition or set of propositions about what to do or how to perform the action (Ryle 1949: 31). One problematic commitment the intellectualist legend holds is that performing an action entails two separate executions, one of planning or considering a set of propositions about an action, and a second in which one performs the action. Ryle's master argument purports to show that the intellectualist legend issues in an infinite regress once its implications are drawn out. Since his regress argument has received ample philosophical attention (Stanley and Williamson 2001; Fantl 2008; Stanley 2011; Wiggins 2012), and is not immediately relevant to Dreyfus's conception of know-how, I will examine a brief anti-intellectualist argument Ryle introduces that is more relevant to Dreyfus and has not received the same attention.

Arguing from the generality of propositions, Ryle claims that a reason or action-guiding maxim "is inevitably a proposition of some generality" and "cannot embody specifications to fit every detail of the particular state of affairs" (Ryle 1949: 31). If an agent when exhibiting know-how is capable of dealing with the details of specific situations more fine-grained than could be captured in any reason or action-guiding maxim, then the know-how must not have the generality of propositions, reasons, or rules. This type of objection takes issue with the invariant or context-free nature of rules, propositions, and representations. One might object to Ryle's argument from the generality of propositions by suggesting that a proposition or action-guiding maxim can be made to capture the specificity of the situation. One might even employ a context-

sensitive demonstrative concept that, as John McDowell puts it, "exploits the presence" of an instance of the action to state how one performs the action (McDowell 1994: 57; Stanley 2011: 169). In response to a question asking how to perform an action, one might say, "it's done this way." In reply, Ryle might resort to a variation on his regress argument that focuses on the criteria for the application of an action-guiding maxim: "A solider does not become a shrewd general merely by endorsing the strategic principles of Clausewitz; he must also be competent to apply them. Knowing how to apply maxims cannot be reduced to or derived from, the acceptance of those or any other maxims" (30). Ryle might argue that applying a specific maxim requires knowing how to apply maxims in general. To avoid a regress of maxims about how to apply maxims, Ryle believes our knowledge bottoms out in a non-propositional ability or know-how about maxim application.

There remains doubt about the success of Ryle's argumentative strategies against the intellectualist legend (Carr 1979; Fantl 2008; Stanley and Williamson 2001; Stanley 2011). Ryle's "intellectualist legend" appears to straw man what might be a reasonable position: many instance of know-how require the employment of rules and propositional knowledge without consideration and reflection and without issuing in a regress. Our phenomenological observations are enough to challenge Ryle's view: we often act successfully and with expertise on propositional knowledge unreflectively or without considering a proposition or rule, for instance when we automatically and unreflectively stop at a red light (Stanley 2011: 14). Research on expertise suggests subjects possessing know-how, typically at the early stages of skill acquisition, reflect on rules and maxims without issuing in a regress. The only viable explanation for such intelligent agency is not, as Ryle holds, that we possess a non-propositional ability for applying rules. One might argue, though doing so is beyond my scope, that the intelligence or understanding involved in these automatic and unreflective acts of rule following do not require a consideration or interpretation of the rule (McDowell 1984). Instead, the understanding implicitly involved might coalesce through practice, custom, and habit (McDowell 1984; 1994). While the debate over know-how is concerned with whether or not the structure of the content of know-how is propositional, know-how is relevant to the choking effect if it is true that know-that requires reflection or attentional investment, as Dreyfus seems to hold. One reason to believe know-that can guide actions unreflectively is that one can act on know-that, stopping at a red light, automatically and without reflecting on a proposition.

2.2 Procedural Knowledge

The procedural-declarative distinction does not exactly mirror the distinction between know-how and know-that, regardless of the fact that both psychologists and philosophers often conflate the two (Cohen and Squire 1980; Devitt 2011; Stillings et al. 1995). The distinction between procedural and declarative knowledge arises first in artificial intelligence (Cohen and Squire 1980; Gardner 1987; Stanley 2011; Winograd 1975). At issue in the artificial intelligence community was whether intelligence should be simulated by representing knowledge using either procedural rules or declarative facts and a set of general inference rules. The procedural view, according to Winograd, considers the simulation of human intelligence to consist in embedding domain-specific knowledge of the world in a program's procedures where the subject's knowledge is

"coextensive" with its operational programs (1975: 186). The declarative view considers knowledge to extend beyond any set of operational procedures. Instead, it views intelligence to consist in a set of general facts and "a quite general set of procedures for manipulating" those facts (1975: 186). Essential to this view of declarative knowledge is that a set of facts describing a domain of knowledge can serve as the basis for conclusions deduced using general inference rules (Winograd 1975: 186). While declarative knowledge appears to identify a form of propositional knowledge a subject can declare or utter, in Winograd's formulation the ability for a system to utter or declare the knowledge is merely incidental. Further, Stanley and Krakauer argue that when it comes to humans possessing propositional knowledge of facts "there is no persuasive reason from the philosophical literature on knowledge to take verbal articulation of its content to be a condition on knowledge" (Stanley and Krakauer 2013: 7). Psychologists have largely come to identify declarative knowledge as "accessible generic knowledge" (Beilock and Carr 2001: 702) or "knowledge that can be consciously and intentionally recollected (Gabrieli 1998: 89; Cohen and Squire 1980). There is, however, no in principle reason why some procedural knowledge could not be propositionally stated or declared even, if we put aside its apparent inaccessibility, a mark some have come to identify as essential to procedural knowledge (Devitt 2011: 209; Gabrieli 1998: 90; Stanley 2011: 154) and which appears to give some reason to believe that procedural knowledge is akin to non-propositional know-how (Devitt 2011: 211–212). Although John Anderson states in an influential paper on the acquisition of cognitive, mathematical skills that "procedural knowledge is represented as productions, whereas declarative knowledge is represented as a propositional network", he considered procedural knowledge, at the time, to also have a propositional structure (Anderson 1982: 370). In later formulations of his Adaptive Control of Thought (ACT) model of skill acquisition, Anderson entertained non-propositional models of representation (Anderson 1983: 46).

It is worth looking more closely at Anderson's theory of skill acquisition since his work is notable both for its attempt to employ the declarative-procedural distinction in cognitive psychology and for the immense influence it has exerted in psychology, and particularly in diagnosing the choking effect (Beilock and Carr 2001; Beilock et al. 2002; Gray 2004; Masters 1992). Anderson's theory of the acquisition of cognitive skill, Adaptive Control of Thought (ACT) outlines three stages of skill acquisition: a declarative stage, knowledge compilation stage, and a procedural stage. Briefly, at the declarative stage declarative facts and rules that are propositionally stated are stored in memory. The rules and facts operate as action-guiding heuristics that through practice are converted from declarative knowledge to procedural knowledge. The transitional stage from declarative to procedural knowledge is the knowledge compilation stage. In the compilation stage two or more sequential productions that are used to solve a problem are combined into one production (Anderson 1983: 235). A benefit of this compilation is speed, since the system is required to represent fewer items and steps in working memory. As Anderson puts it, "the composition of multiple steps into one produces the speed-up and leads to unitary rather than piecemeal application. Verbal rehearsal drops out because proceduralization eliminates the need to hold long-term memory information in working memory" (Anderson 1983: 235). Once the declarative knowledge is completely converted the agent reaches the procedural stage in which "there is further tuning of the knowledge so that it will apply more appropriately, and

there is a gradual process of speedup" (Anderson 1982: 370). One relevant difference between procedural and declarative knowledge apparent in Anderson's use, which mirrors the artificial intelligence distinction, is that the two forms of knowledge are represented differently. Procedural knowledge is represented as a series of combined productions and declarative knowledge is represented as a set of facts stored in a declarative data base (Anderson 1982: 370).[2]

With the distinction between know-how and procedural knowledge in mind, I want to examine the two general models of the choking effect, the representational and anti-representational models. Dreyfus tends to employ the concept know-how, while representationalists tend to employ the concept of procedural knowledge. On Dreyfus's view, experts choke when they are detached and reflective, when they attend to themselves and know-that action-guiding representations or rules. In these cases, know-that interrupts non-representational know-how. Representationalists generally consider choking to occur when attention interrupts the operation of automatic procedural representations.

3 The choking effect

Choking under pressure can occur when perceived pressure elicits an agent's reflection or attention to their performance, technique, or the individual steps involved. Self-focus theories of choking suggest that the mechanism causing subjects to choke is found in the shift from the fluid and unreflective automatic running of a skill, whether a proceduralized skill or non-propositional know-how, to the conscious control of the skilled performance in which case the subject pays explicit attention to the steps involved in the skill's execution. In the absence of the pressure or stress—for example, during practice or in low anxiety situations—the agent typically performs successfully or expertly without attending to the steps involved. In this section, I will outline some of the relevant work in sport psychology on choking under pressure and procedural knowledge.

Masters's (1992) research on choking and explicit/implicit knowledge developed a self-focus model of choking by suggesting that skills learned implicitly without awareness of explicit action-guiding rules are less susceptible to choking since the skill based knowledge is not as accessible verbally and as easily available to the subject's attention (Masters 1992: 354). If the agent is less conscious of action-guiding rules, Masters contends, the likelihood of cognitively reinvesting their automatic action with consciously controlled processing will diminish significantly, thereby diminishing the possibility of choking. Similar studies by Beilock and Carr advance the self-focus or explicit monitoring theory. By focusing on proceduralized sensorimotor skills (e.g. golf putting), they suggest that self-focused attention elicited by pressure disrupts the skillful execution of proceduralized sensorimotor skills (Beilock and Carr 2001: 701). A result of their study is that training under conditions that induce self-consciousness may prove to mitigate choking under pressure, since subjects trained to putt under normal conditions (single-task group) and distracting conditions were more susceptible to choking

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[2] Anderson's model has evolved over the years, although it has maintained its basic form. See Speelman and Kirsner (2005) for a review of Anderson's most recent model, ACT-R and alternative models.

than those trained under self-consciousness inducing conditions. When sensorimotor skills are proceduralized, the subject's attentional resources are capable of processing task-irrelevant information without harming the performance (Gray 2004). Gray, for instance, studied expert baseball players who, unlike novices, were able to attend to extraneous information without affecting their swing. However, when expert batters were prompted to focus on their skillful execution by acknowledging whether the swing was upward or downward their performance degraded. The degradation, as Gray suggests, "is at least partially due to the fact that skill-focused attention in experts interfered with the sequencing and timing of different motor responses involved in swinging a baseball bat" that were proceduralized (Gray 2004: 48, 52).

The work of these sport psychologists would appear to support Dreyfus's model of choking, since he develops a self-focus theory that claims self-consciousness and reflection on know-that disrupt expert performance. We should be careful, however, in thinking that it is justifiable to take these findings in sport psychology as support for Dreyfus's theory of choking. One difficulty is that the concepts of knowledge employed in the psychology literature and in Dreyfus's work are not obviously compatible, largely because Masters, Beilock, Carr and Gray, for instance, have representational view of knowledge implementation while Dreyfus relies on a non-representationalist view. The representationalist view relies on the claim that skill-based practical knowledge is represented procedurally. Procedural representations afford speed and inattention to the skilled task. As numerous studies conclude (Beilock et al. 2002 and Beilock and Gray 2007) when a skill is procedurally represented, attention can be invested in a separate task without diminishing the quality of performance; hence, skilled performances do not generally require continual online attentional monitoring and control. As Beilock et al. put it, "expertise leads to the encoding of task components in a proceduralized form that supports effective real-time performance, without the need for constant online attentional control" (Beilock et al. 2002: 8). Attention causes skilled agents to choke because it interrupts the automatic running of compiled and, thus, proceduralized representational units, by separating the complied units into independent units that are attended to and run separately. As Beilock and Gray suggest, taxing of attentional resources by declarative knowledge may contribute to a decline in performance by also limiting strategic thinking (Beilock and Gray 2007: 434). In contrast to Dreyfus, these representational explanations of choking identify a mechanism that appeals to a shift in the representational control structures underlying skill execution which is accompanied by a shift in the use of one's attentional resources. The breakdown of proceduralized knowledge interrupts the automaticity of fluid expert actions because some representational structures (declarative structures) tax attentional capacities in ways that other representational structures (procedural structures) do not.

4 Dreyfus on coping and choking

I have suggested that Dreyfus's explanation of choking is incompatible with the representationalist explanation. To develop this claim further I will more carefully examine Dreyfus approach to choking and agency. Building on his important critique of artificial intelligence (Dreyfus and Dreyfus 1986, Dreyfus 1992, 2007a, b), Dreyfus has developed a phenomenological theory of choking and expertise that relies on Ryle's

anti-intellectualist thesis that know-how is distinct from know-that. Dreyfus argues that the choking effect should lead us to conclude that the mind does not pervade our agency, and since the mind is not pervasive, intellectualism and representationalism must be wrong. The assumption involved in this variety of reasoning is that states of know-that require acts of reflection that interrupt the automaticity of know-how. It is evident from studies on choking, attention to some forms of know-that does not degrade skilled performance, particularly in cases when know-that is not relevant to the steps involved in performing the skill. For instance, in Beilock et al. (2002) subjects during dual-task conditions identified that something was a target tone or word without performance degradation. Dreyfus, however, is largely concerned with skill based know-that.

Unlike the explanations of choking in the psychology literature, Dreyfus does not employ the concept of procedural knowledge. Instead he employs a distinctive phenomenological vocabulary that attempts to eschew the language of representation. Central to Dreyfus's phenomenology of expertise and agency is the concept of coping. Coping is a form of practical engagement with a specific situation or problem that allows the agent or coper to handle or move through its environment or world. Coping is reminiscent of Heidegger's 'comportment' (Dreyfus 1992) and akin to Merleau-Ponty's 'motor intentionality' (Dreyfus 1992) in that it features not a mental state of intentionality, but a bodily form of intentionality or directedness toward an object, goal, or situation. As Joseph Rouse explains in commenting on the nature of intentionality involved in Dreyfus's conception of coping:

> A fast-breaking basketball player is directed not just toward the ball she dribbles, but also toward the basket, the defenders, the teammates trailing the play or setting up on the wing, the cacophony of the crowd; or rather, to none of these things separately but toward the game in all its complexly articulated interrelatedness (Rouse 2000: 10).

Coping, then, is a holistic form of intentionality, and because it is a bodily intentionality, it does not involve representations or conceptual activity. For Dreyfus and Merleau-Ponty the body grasps what is to be done in a situation, not the mind. What are "grasped are not unified, propositional structures that one can observe and entertain in thought" (2007a: 359). The coper deals with the situation not by deliberately thinking or appealing to an action-guiding rule, but by responding to environmental affordances and "solicitations to act" (Dreyfus 2007a: 359) which register for the coper as "attractive and repulsive forces" (Dreyfus 2007b: 374) that, apparently, draw out behavior more at a level closer to reflex than intentional action. Absorbed coping, or coping at its best, is often identified by Dreyfus as 'flow' experience or being 'in the zone' (Dreyfus 2007b: 373; Dreyfus 2013: 28). When a coper is absorbed, her actions are unreflective, automatic, effortless, and fluid; the absorbed coper is "not even marginally thinking about what [she] is doing" (Dreyfus 2013: 28). Experts whether domain-specific experts or everyday experts (opening doors, driving home, or walking through a crowd) exhibit absorbed coping; in these moments "everything becomes easier, confidence rises, time slows down, and the mind, which usually monitors performance, is quieted" (Dreyfus 2007b; 373). For Dreyfus when an agent becomes an expert, there is not simply a change in the agent's representation of knowledge, as Anderson holds;

instead, the agent's practical knowledge, becomes embodied and context-specific in such a way that the "knowledge" is implemented in the subject's very body or "muscular gestalt", and it does not operate as a represented set of rules or facts available to consciousness (Dreyfus 1992: 249).

Dreyfus's theory of coping identifies know-that as a cause of choking. Know-that, in his view, requires a form of mindedness that interrupts the flow of expertise and tends to reduce the coper to a novice. Dreyfus holds that attention to action-guiding propositions and rules or to reflecting on what one is doing when acting is "accompanied by a severe degradation of performance" (Dreyfus 1986: 17). Imagine you are driving a manual car, a type of action agents are eventually able to perform unreflectively or fluidly. Dreyfus claims that if, due to attention or reflection, "you shifted at the wrong time or into the wrong gear" then you likely "fell victim to 'knowing that' as it interrupted and replaced your 'knowing how'" (17). In the case of an Air Force pilot, Dreyfus reports that by "consciously using rules, he had regressed to flying like a beginner" (17). Know-that is the enemy of expertise and fluid action.

Dreyfus offers a wide range of anecdotal and phenomenological evidence that suggests know-that causes experts to choke or perform at a lower skill level. One argument in defense of the disassociation of know-how and know-that Dreyfus offers is that if you cannot "put what you have learned into words" then, "know-how is not accessible to you in the form of facts and rules" (Dreyfus 1986: 16). The argument is that 1) if something cannot be put into words then it is not (accessible) as a fact or rule; 2) know-how cannot be put into words; 3) therefore, know how is not (accessible) in the form of facts and rules. One issue with this argument is that it questionably identifies a feature of some factual knowledge—it can be verbalized—and then infers that all factual knowledge essentially has this feature (Stanley and Krakauer 2013: 7). Furthermore, an agent's ability to describe how she performs an action can itself improve over time. Upon first learning how to perform the action the agent might lack the right description, yet with more attention to her bodily movement, she will over time develop the right description of how she performed the action. The distinction between know-how and know-that is meant to be a principled distinction in which case the know-how, regardless of the agent's descriptive ability, cannot be propositionally formulated. However, as Dreyfus has formulated matters, he appears committed to fallaciously arguing from ignorance or incredulity.

Consider for a moment that Dreyfus is right to disassociate know-how and know-that and correct in claiming that know-that is a cause of choking. The natural question to consider is: why does know-that cause choking? Dreyfus's standard response is that reflection, attention or simply mindedness, which accompanies know-that, causes choking. We should then ask: what, according to Dreyfus, is it about attention or mindedness that causes choking? It is at this point that he lacks the kind of explanation available to representationalists since he believes choking is avoided when action is mindless and absorbed. Procedural representational structures do not require attention in the same way as declarative structures, due to the very organization of both structures, but that does not entail they are mindless or non-cognitive. Anderson's model of knowledge compilation explains why procedural knowledge does not require attention and offers the explanatory resources for why self- or skill-focused attention is often at odds with fluid and expert action, but not when it is focused on other features of the situation or environment (Beilock and Carr 2001; Beilock et al. 2002; Wulf 2007). Dreyfus's claim

that absorbed coping is "mindless" appears to exclude such a possibility, since attentional focus qualifies as a form of mindedness (Dreyfus 2007a: 353).

Dreyfus is not fully justified in formulating his theory of choking in terms of know-that interrupting know-how, since it is reasonable to hold the view that unreflective know-that and the unreflective use of action-guiding cues does not require performance degrading forms of reflection or attention. Dreyfus might choose to reframe his claims along the lines of the procedural-declarative distinction. There is, in fact, good reason to think that when he claims that know-that interrupts know-how he has in mind the procedural-declarative distinction. One reason in support of this reformulation is that Dreyfus's theory of expertise relies heavily on knowledge of rules at the beginning stages of skill development (novice, advanced beginner, competent, and proficient all require declarative knowledge of rules). In these early stages, especially the stages of novice, advanced beginner, and competent, the subject knows how to perform a particular action (Dreyfus 1986, 2002a, b), but the action relies on what is essentially declarative knowledge of context-free rules that, given Dreyfus's description of skill development, appear to become "proceduralized" through experience. If this is right, then Dreyfus should be understood as arguing that declarative knowledge interrupts procedural knowledge.

5 Dreyfus's Dilemma

Reformulating Dreyfus's model of choking in terms of the procedural-declarative distinction burdens him with a double commitment creating a dilemma for his account of choking. If by stating that know-that interrupts know-how he means that declarative knowledge interrupts procedural knowledge, then he needs an account of why declarative knowledge interrupts procedural knowledge. An argument cannot be made a priori or anecdotally. The empirical and explanatory work of sport psychologists would serve Dreyfus well: self-conscious attention elicited by pressure or stress tends to interrupt the automaticity experts and agents can exploit once their skill-based knowledge has been procedurally encoded. The work of these psychologists is underwritten by a commitment to a cognitivist understanding of procedural knowledge. If Dreyfus desires an empirically grounded theory of choking and unreflective action, one that relies on more than phenomenology, anecdotal remarks, and athletes' stories, he would be wise to appeal to the empirically informed choking literature. Relying on these findings, however, would commit him to a cognitivist and representational model of procedural knowledge and embodied coping. On the one hand, Dreyfus would do well to appeal to the choking literature and endorse the commitment to cognitivism and representationalism, but on the other hand, his commitment to an anti-representational, dynamical model of coping forbids him from taking on such a commitment. I will suggest that this leaves Dreyfus in an awkward place: he cannot currently, provided his anti-representational commitments and views on know-that, make sense empirically of why experts choke, without providing an empirically informed dynamical model of choking.

In reply to my charge Dreyfus might suggest that his model of choking claims that reflection on oneself or on action-guiding rules (declarative knowledge) interrupts the flow of absorbed coping (proceduralized knowledge) and that such an appeal to

reflection or self-consciousness is sufficient to explain why choking occurs. Such a reply is unsatisfactory since what should be explained is why reflection or a reinvestment of cognitive capacities degrades one's performance. The cognitivist model of procedural knowledge has the resources to explain why reinvestment or self-focus results in choking. These resources rely on claims about how knowledge is encoded or represented and why procedural encoding lubricates action. Dreyfus might rebut my reformulation of his model of choking by suggesting that it is indeed know-how and not procedural knowledge he is truly concerned with. Know-how identifies a particular state, and it is not clear why a shift from a know-how state to a know-that state would result in choking, unless for some reason know-that states essentially require reflection, a position there is good reason to question. Even if we accept the point about know-that and reflection, Dreyfus still must explain why reflection is so damaging. To do so, he would need to identify some claim akin to the kind of claim cognitivists make about procedural knowledge when they claim cognitive reinvestment impacts the running of procedural knowledge and the automaticity of action. It is clear that in order to overcome the dilemma, Dreyfus could give up on his commitment to connectionist and dynamical models and bite the cognitivist bullet. This option is clearly too much to ask of a philosopher who has dedicated his entire career to bucking the cognitivist model of intelligence (Dreyfus 1992). A second option would be to offer a connectionist or dynamical model of practical or skill-based knowledge that can do the same explanatory work as the cognitivist model of procedural knowledge, without offering only a descriptive account as some earlier drive theories of choking did (Beilock and Gray 2007: 429). What he would presumably want is a dynamical approach that modeled a distinction akin to the cognitivist's declarative and procedural distinction, but could explain without appeal to representations why choking occurs.

It is worth examining this second option some. Drawing on Walter Freeman's dynamical theory of learning, Dreyfus argues that neural nets can model skilled agency without appealing to propositions or representations (Dreyfus 2002a: 381). A drawback of Dreyfus's invocation of Freeman's work is that it examines rabbit olfaction and not human agency. A central aim of Freeman's research on olfaction is to answer the following question: "how does the brain recognize that signals from different collections of receptors all refer to the same stimulus?" (Freeman 1991: 79). Initially in his research he attempted to employ the concept of representation to suggest that the spatial pattern of neurological activity in the olfactory bulb provided a "snapshot" of the odorant, "that each burst served to represent the odorant" (Freeman Freeman and Skarda 1990: 376). One difficulty he faced in employing the concept of representation is that the odor stimulant could be stable, but the spatial pattern of neurological activity—which was meant to represent the odor—caused by two distinct acts of inhaling would be different based on the rabbits' experience of odors. In one act of inhaling the rabbit inhales an odor of sawdust and a certain pattern of neurological activity occurs. After exposure to and recognition of the smell of a banana, which creates its own distinct pattern of bulbar activity, upon inhaling the sawdust again, a pattern of bulbar activity occurs that differs significantly from the original pattern of activity. As Freeman remarks, "the change shows that the bulbar activity is dominated more by experience than by stimuli; otherwise, sawdust would always give rise to the same plot" (Freeman 1991: 84). The bulbar activity cannot, then, serve as a representation of the odor, since, put simply, representations are, presumably, invariant and the

bulbar activity is variant relative to experience, or (following the Hebb rule) the strengthening of neurological connections due to the synapses between neurons firing together. Freeman's model eschews appeal to representations, since at the neurological level the bulbar activity dynamically changes in response to experience and stimuli in such a way that is sensitive to the context of each inhalation. Dreyfus finds Freeman's model of brain dynamics, one that parallels, according to Dreyfus, Merleau-Ponty's 'intentional arc', a useful model for developing an anti-representational model of skillful coping since it can "provide a model of how the past can affect present perception and action without the brain needing to store specific memories" or representations at all (Dreyfus 2002a: 374). If Freeman and Dreyfus are right, then representations should not play an explanatory role at any level of analysis when explaining the rabbits' neurological activity and overt behavior. Prinz and Barsalou, however, challenge Freeman's anti-representationalism by accepting that there is dynamical variability at the neurological level, but that without appealing, at a higher level, to a representation, the behavior of the rabbit, which remains constant, cannot be explained. Prinz and Barsalou argue that "although there is extreme context sensitivity at the lowest level of analysis, there is also a somewhat higher level of analysis at which [representational] stability emerges through function" (Prinz and Barsalou 2000: 61). Distinct neurological states may vary; however, for explanatory reasons, it is necessary to treat the states as functionally equivalent, in order to explain the constancy of the rabbits' behavior.

A similar point concerning representations can be made about dynamical perspectives on action that is relevant to the choking effect and procedural knowledge. In a study of implicit knowledge, Reed, McLeod, and Dienes (2010) argue that catching a ball requires the representation of a rule, though the rule need not be reflected upon or represented symbolically in such a way that it can be recombined with other representations. The rule Reed et al. have in mind is a rule that guides the subject's sense of where to position herself to catch the ball. The subject's positioning is based on controlling changes in the angle of elevation of gaze relative to their position to the ball's destination. Commenting on this interception theory, Reed et al. write, "it is assumed that the fielder does not make a prediction about where to go from the ball's initial flight parameters. Rather, he operates a servo mechanism which continually adjusts his speed as he runs. The strategy ensures that the fielder arrives at the place where the ball will land at the same time as the ball (if he can run fast enough to keep the angle of gaze changing at the appropriate rate) but does not tell him where that point is in advance" (Reed, McLeod, Dienes 2010: 65). Subjects are not only unaware of using the angle of gaze rule, when they are made aware of such a rule they report inaccurately on how the angle changes. A rule inaccessible to the subject guides her performance, and in order to make sense of the subject's intelligent behavior, it must be procedurally represented—even if, as Reed et al. suggest, the rule could be modeled using a connectionist network, or as I would suggest, the subject's action described dynamically. Such studies might provide evidence for the view that procedural knowledge relies on representational structures, without simultaneously committing us to the view that every aspect or moment of an agent's action must be under the guidance of such control structures. Such procedural knowledge would be rule based, representational, unreflective, automatic, and action-guiding. Such a theoretical posit, as I've argued, is central to explaining why subjects choke.

6 Conclusion

Dreyfus's model of choking does not offer a clear mechanism for why agents choke. First, if know-how is a form of know-that, as some philosophers hold, then the radical disassociation his theory of choking depends on would collapse. Second, some forms of agency, e.g. interception, do involve rule based knowledge, a point incongruous with his model of embodied action, but not the embodied models of some representationalists. Third, there are good reasons to think reflection and attention do not always accompany know-that. Fourth, unlike Dreyfus's model, representational models can explain why attention is harmful, without claiming embodied action is mindless. Fifth, Dreyfus's dynamical theory of agency, lacks, so far, empirical and conceptual evidence that shows a non-representational model of choking can do explanatory work representational models cannot. A potential upshot of my criticism is that there might be a place for the development of an empirically informed dynamical systems theory of choking, even if a clear model is not set out in Dreyfus's work. However, such a model might still require at least some explanatory appeals to representations or procedural rule-like structures similar to the angle of gaze

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