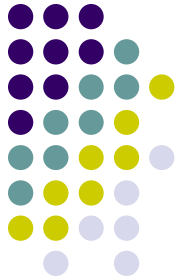
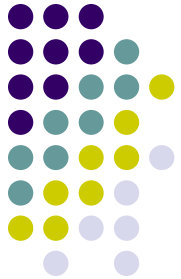
BVSR ≠ Buffy Vampire Slayer Relationships



Why Creativity Cannot Be Sighted:

Blind Variation as
Philosophical Proposition *and*
Psychological Hypothesis

Introduction



- Some issues in the cognitive sciences are just as much philosophical as psychological
- Examples:
  - mind-body problem
  - epistemology
  - determinism versus free will

Introduction

- In particular,
  - Philosophical analysis is required to define the nature of the phenomenon: e.g.,
    - What? Why?
  - Psychological research is required to discover the empirical facts about the phenomenon: e.g.,
    - How? When? Where? Who?
- Specific example discussed here:

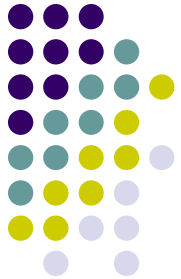
Introduction

- Donald T. Campbell's (1960) "Blind variation and selective retention in creative thought as in other knowledge processes"
  - Stimulated controversy for the next half century
  - Furthermore, this controversy engaged both philosophers and psychologists
  - where proponents and opponents represent both disciplines:
    - The debate cuts across disciplinary lines

Introduction

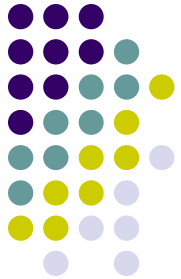
- Hence, here I will examine BVSR as
  - a philosophical (analytical) proposition, and
  - a psychological (empirical) hypothesis
- arguing that the two are mutually reinforcing
  - the former provides the logical necessity
    - i.e., *why* creative thought requires BVSR
  - the latter provides the empirical explanation
    - i.e., *how* BVSR operates to produce creative thoughts

BVSR as philosophical proposition



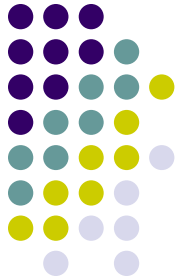
- Though published in *Psychological Review*, the philosophical nature of BVSR was clear
  - First, Campbell quoted at great length Alexander Bain (1855), Paul Souriau (1881), Ernst Mach (1896), and Poincaré (1921)
  - Second, as implied by the title, Campbell was clearly concerned with epistemology – the "knowledge processes" in the title
- Indeed, according to the current editor, this paper could not be published in *PR* today!

BVSR as philosophical proposition



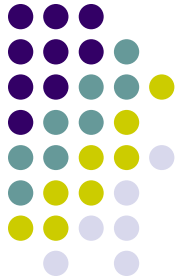
- In addition, rather than develop BVSR's psychological side, Campbell (1974) chose to elaborate the philosophical aspect into his well-known *evolutionary epistemology*
- an elaboration that had explicit connections with the ideas of "conjectures and refutations" in Karl Popper's (1963) philosophy of science developed at almost the same time
- to wit, "bind variation" ≈ "bold conjecture"

BVSR as philosophical proposition



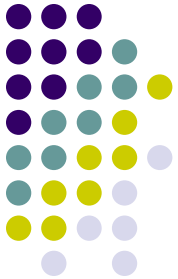
- It was this later version of Campbell's theory that had such a big impact on philosophical thinking both
  - *Pro* (Bradie, 1995; Briskman, 1980/2009; Heyes & Hull, 2001; Kantorovich, 1993; Nickles, 2003; Stein & Lipton, 1989; Wuketits, 2001), and
  - *Con* (Kronfeldner, 2010; Thagard, 1988)

BVSR as philosophical proposition



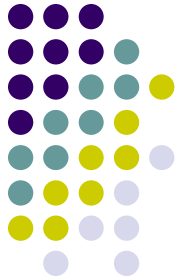
- That said, Campbell's (1960, 1974) theory was never really logically adequate because
  - One, he never defined creativity!

BVSR as philosophical proposition



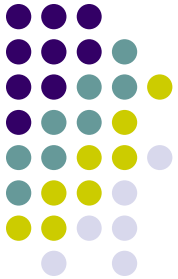
- That said, Campbell's (1960, 1974) theory was never really logically adequate because
  - Two, his definition of variational "blindness" was "connotative" rather than "denotative"
    - "an essential connotation of blind is that the variations emitted be independent of the environmental conditions of the occasion of their occurrence" (p. 381)
    - "a second important connotation is that the occurrence of trials individually be uncorrelated with the solution, in that specific correct trials are no more likely to occur at anyone point in a series of trials than another, nor than specific incorrect trials" (p. 381).

BVSR as philosophical proposition



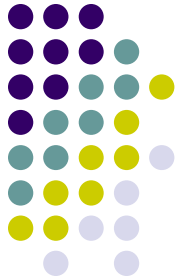
- Later, he tried to remedy the latter by introducing alternative terms, such as “unjustified,” but without appeasing his critics
- Campbell, in fact, missed a golden opportunity, for if he had provided precise formal definitions, the relation between BVSR and creativity would be shown to be essential rather than hypothetical
- To be specific …

BVSR as philosophical proposition



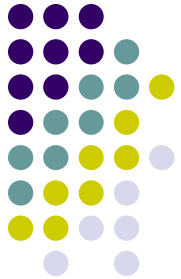
- Given the set *X* of ideas (or responses):
- x_i, where $i = 1, 2, 3, \ldots k$ and $k \geq 1$
- Each idea has three *subjective* parameters
  - *initial* generation probability: p_i
    - where $0 \leq p_i \leq 1$, $\Sigma\, p_i \leq 1$
  - *actual* utility: u_i, where $0 \leq u_i \leq 1$:
    - viz. probability of selection and retention
  - *prior* knowledge of u_i: v_i
    - where $0 \leq v_i \leq 1$ (e.g., ignorance to expertise)

BVSR as philosophical proposition



- Now, on the one hand, the creativity of idea x_i is given by the multiplicative function:
  - $c_i = (1 - p_i)u_i(1 - v_i)$, where $0 \leq c_i \leq 1$
  - where
    - $(1 - p_i)$ = the idea's originality, and
    - $(1 - v_i)$ = the idea's surprisingness
  - i.e., to be creative is to be original, useful, and surprising, where the multiplicative function ensures that unoriginal, useless, and/or obvious ideas cannot be deemed creative regardless of the magnitude of the other two attributes

BVSR as philosophical proposition

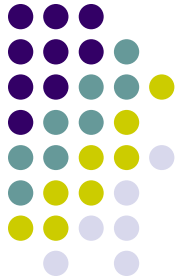


- The above definition can also be seen as a formal quantitative representation of common qualitative three-criterion definitions, e.g.,
  - US Patent Office: new, useful, and nonobvious
  - Boden (2004): novel, valuable, and surprising
  - Amabile (1996):
    - novel
    - appropriate, useful, correct, or valuable
    - heuristic rather than algorithmic

BVSR as philosophical proposition

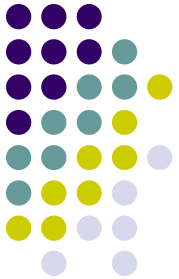
- On the other hand, the sightedness s_i of idea x_i is given by:
  - $s_i = p_i u_i v_i$,
  - where $0 \leq s_i \leq 1$ and $s_i = 1$ when $p_i = u_i = v_i = 1$
  - Thus, an idea's blindness is defined by $b_i = 1 - s_i$
- Moreover, the sightedness S of the entire set X is given by the average of the k s_i's, namely:
  - $S = 1/k \; \Sigma \; p_i u_i v_i$, where $0 \leq S \leq 1$
  - Hence, the set's blindness is defined by $B = 1 - S$

BVSR as philosophical proposition



- Blindness measures s_i and S do not require that the ps be either equiprobable or random
- On the contrary, blindness only requires that
  - the ps and us be "decoupled" (i.e. $p_i u_i \rightarrow 0$) or,
  - if not decoupled, that the vs approach 0
- Indeed, B can equal 0 even when the ideas (or responses) are generated by a deterministic mechanism, such as a systematic search (e.g., all possible Cartesian or polar coordinates)
- This definition thus avoids a common misunderstanding regarding BVSR

BVSR as philosophical proposition

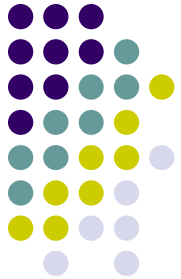


- The foregoing definitions have important implications
  - **Part I**: c_i and s_i
  - **Part II**: c_i and S

BVSR as philosophical proposition

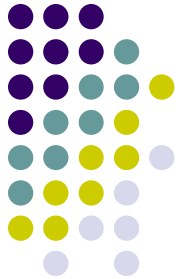
- **Part I**: c_i and s_i
- *First,* highly sighted ideas *cannot* be highly creative:
  - In particular (where "→" indicates "approaches"),
    - $s_i \rightarrow 1$ as $p_i \rightarrow 1$, $u_i \rightarrow 1$, and $v_i \rightarrow 1$, but
    - $c_i \rightarrow 1$ as $p_i \rightarrow 0$, $u_i \rightarrow 1$, and $v_i \rightarrow 0$
  - i.e., highly creative ideas *must* be highly blind

BVSR as philosophical proposition



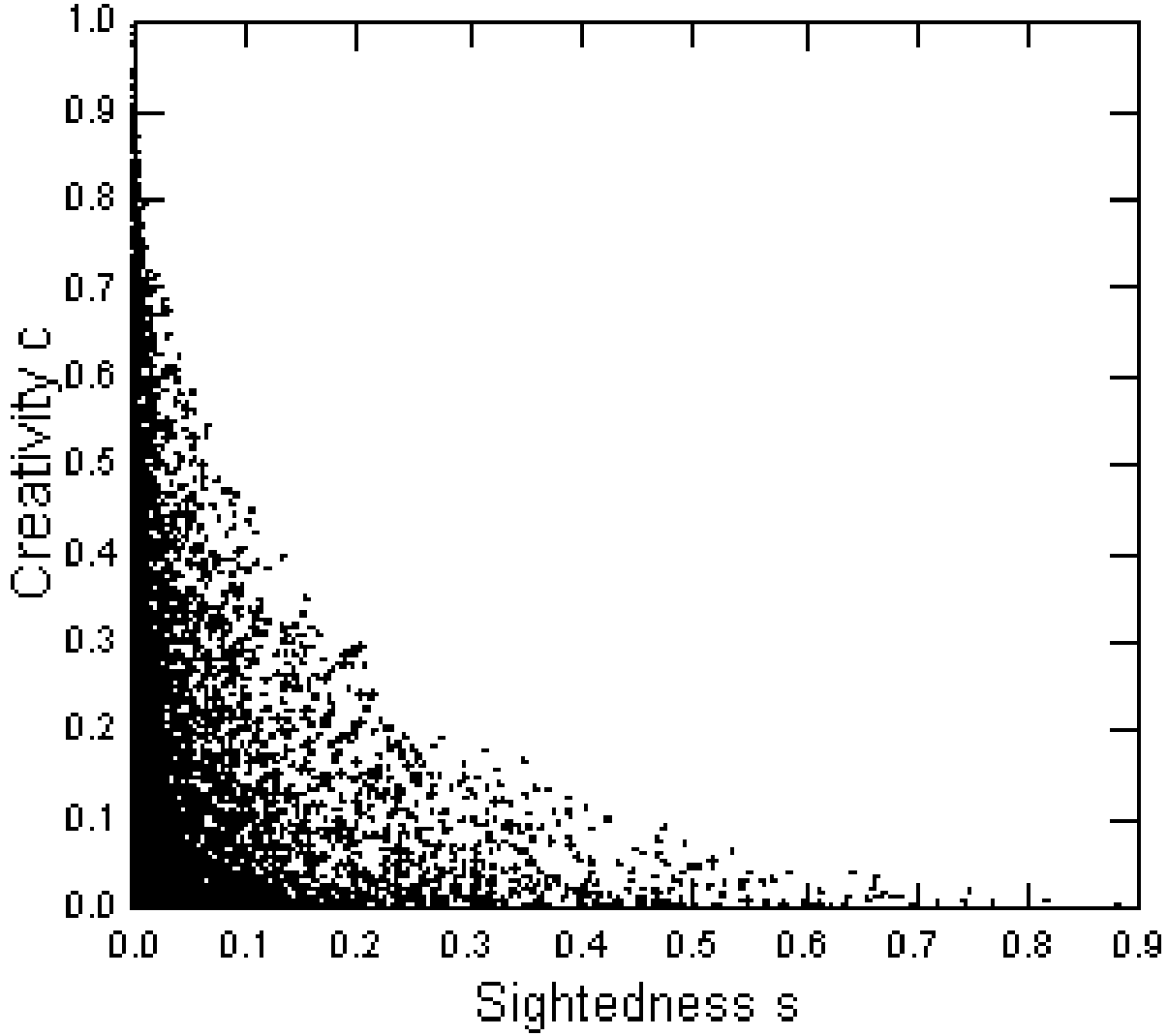
- *Second*, highly unsighted ideas can *vary* from the highly creative to the highly uncreative:
  - If $u_i = 0$ and $v_i = 0$,
  - then $c_i = s_i = 0$ for all values of p_i
  - i.e., absolutely useless ideas can be neither creative nor sighted
  - Hence, highly blind ideas can be highly creative, highly uncreative, or anything between!
  - By definition, we cannot know c_i without conducting a generation and test to assess u_i

BVSR as philosophical proposition

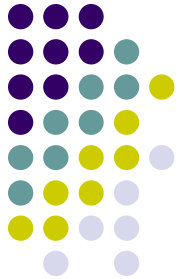


- *Hence*, the joint distribution of sightedness and creativity is necessarily triangular
- i.e., expected variance $\sigma^2(c) \rightarrow 1$ as $s \rightarrow 0$
- e.g., the following Monte Carlo simulation (Simonton, in press):

BVSR as philosophical proposition



BVSR as philosophical proposition

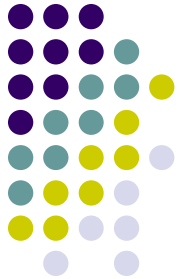


- **Part II**: c_i and S
- *First*, highly sighted sets *cannot* contain highly creative ideas: e.g.
  - If $u_1 = 1$, $S \rightarrow 1$ as $p_1 \rightarrow 1$, and $v_1 \rightarrow 1$, and
  - for all $i \neq 1$ where $u_i = 0$, $p_i \rightarrow 0$ (and $v_i \rightarrow 1$) implying that $k \rightarrow 1$ (because $\Sigma\, p_i \leq 1$), whereas
  - But if $u_1 = 1$, $c_1 \rightarrow 1$ as $p_1 \rightarrow 0$, and $v_1 \rightarrow 0$

BVSR as philosophical proposition

- *Second*, highly unsighted sets can contain ideas that vary from the highly creative to the highly uncreative, for
  - $S = 0$ when $p_i u_i v_i = 0$ for all i, indicating that any idea with $p_i > 0$ and $u_i = 1$ must have $v_i = 0$, a stipulation consistent with $c_i >> 0$
  - viz. if $u_1 = 1$ and $v_1 = 0$, then $c_1 \rightarrow 1$ as $p_1 \rightarrow 0$
- e.g., (pseudo-)serendipitous discoveries
- Hence, a perfectly blind set can contain a highly creative idea

BVSR as philosophical proposition

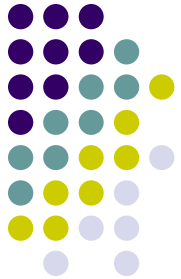


- Consequently, BVSR has an essential relation with creativity
  - In particular, it remains the only method available to distinguish between
    - $p_i \approx 0$, $u_i \approx 1$, and $v_i \approx 0$,
      - the highly creative idea, versus
    - $p_i \approx 0$, $u_i \approx 0$, and $v_i \approx 0$,
      - a useless but equally original idea
  - In a nutshell, BVSR is used to assess utilities when we do not already know them
  - We are “blind” to the actual and precise utility

BVSR as philosophical proposition

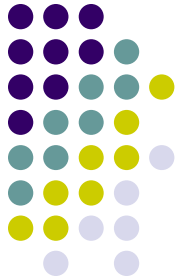
- Brief digression (cf. Nickles, 2003):
  - Plato's *Meno* problem
  - The "No Free Lunch" Theorem

BVSR as philosophical proposition



- Brief digression (cf. Nickles, 2003):
  - Plato's *Meno* problem
    - Q: How do we know that we know something without knowing it in advance?
    - A: We don't – we can only engage in BVSR to test hypotheses or conjectures against a set criterion
    - Indeed, we may even have to use BVSR to identify the best criterion!

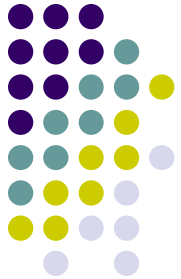
BVSR as philosophical proposition



- Brief digression (cf. Nickles, 2003):
  - The “No Free Lunch” Theorem
    - Q: How do we know that BVSR provides the optimal procedure for finding the best or only solution?
    - A: We know it doesn’t – BVSR just provides the *only* procedure for identifying the most creative idea should any creative idea exist
    - BVSR can even be used to create an algorithm for solving future problems of a similar type
    - Yet when that happens, any solution generated by that algorithm will cease to be creative!

Now … we've got to switch planes

BVSR as psychological hypothesis

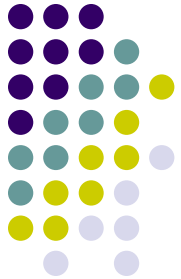


- Although Campbell (1960) made a minimal attempt at grounding BVSR in empirical psychological research, subsequent BVSR advocates in psychology attempted to do so (viz., Damian & Simonton, 2011; Martindale, 1990; Simonton, 1985, 1988, 1999, 2007, 2009, 2010, 2012)

BVSR as psychological hypothesis

- Yet these later attempts have attracted considerable criticisms as well (e.g., Dasgupta, 2004, 2010, 2011; Ericsson, 1999; Gabora, 2005, 2007, 2010, 2011; Russ, 1999; Schooler & Dougal, 1999; Sternberg, 1998, 1999; Weisberg, 2004, Weisberg & Hass, 2007)

BVSR as psychological hypothesis

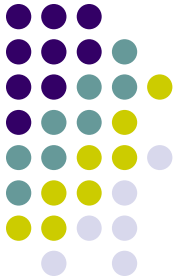


- However, if the previous philosophical analysis has any validity, then the BVSR-creativity connection may not be an entirely empirical question!
- Rather, the BVSR-creativity relation might be partly comparable to a statement like “all bachelors are unmarried”
- albeit far more nuanced because blindness and creativity are not equivalent

BVSR as psychological hypothesis

- In particular, although “all bachelors are unmarried” is necessarily true (in the English language),
- and the statement “all highly creative ideas are highly blind” is also necessarily true (viz., whenever $u_i = 1$, $c_i \rightarrow 1$ as $b_i \rightarrow 1$)
- the converse statement “all highly blind solutions are highly creative” is necessarily false (e.g., if $u_i = 0$ and $v_i = 0$ but $p_i = 0$, then $c_i = 0$ though $b_i = 1$)

BVSR as psychological hypothesis

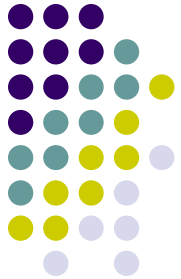


- Indeed, the last statement can be better converted into empirical questions:
  - What proportion of highly blind ideas is highly creative?
  - And does that proportion vary across individuals and fields?

BVSR as psychological hypothesis

- Nor are those the only empirical questions elicited, for we also can ask:
  - What cognitive processes and behavioral procedures generate sets that contain at least one idea where $p_i \rightarrow 0$, $u_i \rightarrow 1$, and $v_i \rightarrow 0$?
  - What characteristics enable a person to engage in the foregoing cognitive processes and behavioral procedures?
  - What environmental factors affect the person's ability to engage in those processes or procedures?

BVSR as psychological hypothesis

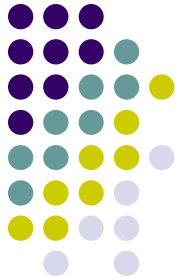


- To illustrate, what is the function (+ or -) of
  - reduced latent inhibition?
  - remote association and divergent thinking?
  - behavioral tinkering?
  - general intelligence?
  - domain-specific expertise?
  - psychoticism or “positive” schizotypy?
  - bilingualism and multicultural experiences?
- These are all valid empirical questions!

BVSR as psychological hypothesis

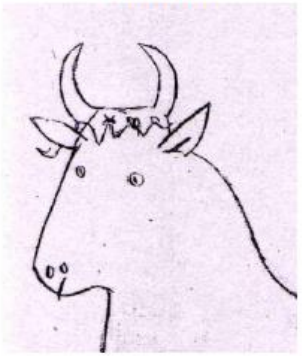
- Furthermore, BVSR provides the basis for combinatorial models that lead to precise and comprehensive predictions regarding:
  - Cross-sectional variation and longitudinal changes in creative productivity
  - Multiple discovery and invention
  - Scientific and technological growth
- See Simonton (2004, 2010)

BVSR as psychological hypothesis

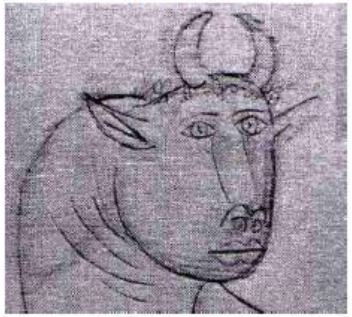


- Lastly, beyond the foregoing nomothetic analyses, BVSR can be used as the basis for case studies of historic acts of creativity and discovery: e.g.
  - Galileo's telescopic observations (Simonton, 2012)
  - Picasso's *Guernica* (Damian & Simonton, 2011; Simonton, 2007) … e.g., backtracking

Sketch 6

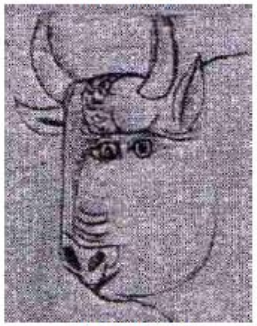


Sketch 10



Sketch 11

Sketch 12



Sketch 15

Sketch 19

Sketch 22

Sketch 26

Sketch 27

Final Version

Conclusion

- Hence, BVSR-creativity has both philosophical and psychological validity