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Psychology: A Giant with Feet of Clay

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Best regards

The authors

PSYCHOLOGY: A GIANT WITH FEET OF CLAY

Psychology: A Giant with Feet of Clay

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Abstract

The aim of the current study has been to highlight the theoretical precariousness of Psychology. The theoretical precariousness has been evidenced through a review of psychological “core-constructs” whose definitions were thoroughly searched in 11 popular introductory textbooks of psychology edited between 2012 and 2019 and in an APA dictionary of Psychology (VandeBos, 2015). This analysis has shown unsatisfactory or discordant definitions of psychological “core-constructs”. A further epistemological comparison between psychology and three “harder” sciences (i.e., physics, chemistry and biology) seemed to support the “soft” nature of psychology: a minor consensus in its “core” and a minor capacity to accumulate knowledge when compared to the former “harder” sciences (Fanelli, 2010; Fanelli & Glänzel, 2013). This comparison also seemed to support the “pre-paradigmatic” condition of psychology, in which conflicts between rival schools of thought hamper the development of a real unified paradigm (Kuhn, 1970). To enter a paradigmatic stage, we propose here evolutionary psychology as the most compelling approach, thanks to its empirical support and theoretical consistency. However, since the skepticism about “grand unifying theories” is well disposed (Badcock, 2012), we suggest that evolutionary psychology must be intended as a pluralistic approach rather than a monolithic one, and that its main strength is its capacity to resolve the nature-nurture dialectics.

Keywords: Theoretical Psychology, Philosophy of Science, Evolutionary Psychology, Introductory Textbooks, Theoretical definitions

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1
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3
4
5 “In psychology there are experimental methods and conceptual confusion...The existence
6
7 of the experimental method makes us think we have the means of solving the problems that trouble
8
9 us; though problem and method pass one another by”
10

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12
13
14 Wittgenstein L. *Philosophical investigations*. Oxford: Blackwell, 1953, quot. in Wakefield, 2014, p
15
16 38.
17

21 **A shaky foundation: a lacking concept of “mind”**

22
23
24 Psychology is as an atypical science, as its main object of study is not clearly defined.
25
26 Based on its etymology - ψυχή/psyché, soul and λογος/logos, science - it should be the “science of
27
28 the soul” however, it is somewhat peculiar that the concept of “soul” is strongly rejected by
29
30 scientists as a unit to be investigated. Psychologists and researchers usually limit their scientific
31
32 focus to “mind and behavior” (*see* Table A1). The first signs of confusion may thus be related to the
33
34 current use of the prefix “psych-” in all the main disciplines in this field, although its etymological
35
36 meaning is typically refused. However, even if the term “soul” (and thus the “psych-” prefix) was
37
38 regarded as an irrelevant historical legacy and the contemporary focus was only on the study of
39
40 “mind and behavior”, things would not be better. In fact, the fundamental pillar of psychology, the
41
42 concept of mind, is neither satisfactorily nor unanimously defined ¹ (Table A1; Wallach e Wallach,
43
44 2012). Remarkable efforts have been made in this respect, like the definition proposed by Siegel²
45
46 (Siegel, 2012, 2016). This formulation might solve the issue in the near future however, it is still not
47
48 shared by a sufficient proportion of the scientific community. Definitions of mind popular today are
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55

56
57 1 Behavior is a less debated term, but still it is not as easy-to-use as it first appears, since it can be intended as
58 “overt” or “covert” or both (Table A1).

59
60 2 “The mind is an embodied and relational process that regulates the flow of energy and information” (Siegel,
61 2012, p.3)

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1 materialistic - mind interpreted exclusively as a brain activity (e.g. Cacioppo & Freberg., 2013) or,
2
3 more often, descriptive-set - mind intended as list of activities moving within it (*see* Table A1).
4

5
6 However, there are several critical aspects that hinder the *materialistic* definition
7
8 (Porcelli, 2009; Benovsky, 2016). Among the most prominent is that there may be emergent
9
10 properties, i.e. properties that a system shows which are not found in the single parts composing the
11
12 system itself, and this might happen between mind and brain as well (Tononi, Sporns, & Edelman,
13
14 1994; Edelman & Tononi, 2001; Edelman, 2003; Bedau & Humphreys, 2008). Moreover, the brain
15
16 and the body are directly affected by the mind itself, which operates as a “social organ” that
17
18 converts relational experiences in the brain and somatic processes (e.g. Tomasello, 1999; 2019;
19
20 Danese et al., 2011; Lanius, Vermetten & Pain., 2010; Van der Kolk, 2015). On the other hand, the
21
22 descriptive-set definition, although more supported than the materialistic one, seems to lack
23
24 conceptual consistency (Table A1). Activities (such as thinking and reasoning) and concepts (such
25
26 as cognition and emotions) included to define the mind are themselves circularly defined by the
27
28 formulation of mind itself, therefore resulting in a vacuous recursion (Table A1-A6). For example,
29
30 “mind” is often conceived as a list of activities that includes “thinking” or “thoughts” (Table A1),
31
32 when, at the same time, the definition of “thinking” generally always refers to its “mental” nature as
33
34 a characterizing feature (Table A5).
35
36
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42 Most psychologists (more often implicated in practice rather than in theory)
43
44 consider the definition of mind as a matter of no significance, leaving it to the philosophers and
45
46 therefore unconsciously adopting an ontological approach that could insidiously affect their own
47
48 clinical or scientific activity.
49
50
51

An *unsteady* building

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53
54 This first fragile condition (that is a lacking concept of mind) is necessarily followed by
55
56 many cumbersome consequences: most of the psychological constructs are not satisfactorily defined
57
58 (*see* Table A2-A6). The cornerstones upon which psychological science is built seem to falter or fit
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60
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62

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1 only in the context in which they have been implemented (Staats, 1999). The idea of “*language-*
2
3 *game*” (Wittgenstein, 1953) (i.e., the comprehension of a given word exclusively in the context in
4
5 which it is used) could be called into question to depict this condition. Nevertheless, if the
6
7 “*language-game*” theory works in semantics, it does not in the field of science, as it undermines
8
9 many fundamental processes of the scientific enquiry, like replicability and inter-subjectivity
10
11 (Wilson, 1999). **Cognition, consciousness, emotion, intelligence, mind and thinking**, are concepts
12
13 usually used by psychologists and psychiatrists around the world. Nevertheless, *no one seems to*
14
15 *agree on what they really are* (as reported from Table A1 to Table A6). Several other terms might be
16
17 less debated, presenting a larger degree of agreement (i.e., **attention, behavior, decision-making,**
18
19 **language, learning, memory, motivation, reasoning, perception, problem-solving,** and
20
21 **sensation**).

22
23
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26
27
28 However, a real accordance is far from reached; more importantly, these concepts are often
29
30 ambiguous, overlapping and circularly defined by the former concepts quoted above which, in our
31
32 opinion, lack a satisfactory conceptualization (see tables A1-A6). All this results in *non-conclusive*
33
34 *definitions*. The reasons that may account for such *theoretical chaos* may be attributed to the recent
35
36 classification of Psychology as a science (Fernald, 2007; Goldfried, 2018) as well as the peculiar
37
38 epistemological status of this discipline, dealing with subjectivity and objectivity at the same time
39
40 (Jung, 1947; Gaj, 2016)³ or the degree of high complexity in which is involved (Staats, 1999;
41
42 Fernald, 2007; Fanelli & Glänzel, 2013).
43
44
45
46
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48
49

The clinical war: conflicts between “schools of thought”

50
51 Scientific and clinical psychology are controversially related to each other (Meehl, 1954;
52
53 Miller, 2001; Gaj, 2016). This contrast finds its reason in the peculiarity of the clinical context in
54
55 which the nomothetic scientific approach conflicts with the necessary enhancement of the patient's
56
57

58
59
60 3 The objective study of subjective experience (e.g. consciousness) presents *par definition* epistemological difficulties
61 since it compares apparently irreducible entities (objective properties *measured* by the scientific enquiry) with inner
62 and private mental states (sometimes referred to as *qualia* ; states that cannot be measured and objectivised).
63

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1 idiographic perspective. Within this controversy, the theoretical chaos in the psychotherapeutic field
2
3 is perhaps much wider (Melchert, 2016; Goldfried, 2018). Although conciliatory efforts do exist,
4
5 most of the psychotherapeutic concepts are used in the specific context in which they were first
6
7 formulated and are being ignored, even mocked, by other “schools of thought” (Krantz, 1987;
8
9 Tracy, Robins & Gosling, 2005). The definition of psychotherapeutic constructs is just as confusing.
10
11 The same phenomenon, substantially unmodified, is “discovered” and re-named several times
12
13 (Goldfried, 2018) [a phenomenon we propose here to label “*nominomania*”, a neologism we have
14
15 coined in this regard]. Furthermore, the term “school of thought”, at least if taken literally, seems to
16
17 be more appropriate in spiritual, political or ideological fields, not in scientific areas.
18
19
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21

22
23 In this regard, often unification claims, that have a long and diverse history in psychology
24
25 (e.g. Krantz, 1987; Royce, 1987; De Groot, 1990; Kimble, 1994; Anderson, 1996; 2008; Staats,
26
27 1999; Sternberg & Grigorenko, 2001; Sternberg, 2005; Henriques, 2004, 2011; Glenberg, 2010;
28
29 Gaj, 2016; Melchert, 2016) have been intended as a dangerous threat to scientific pluralism (e.g.,
30
31 Toulmin, 1987; Gergen, 1988; McNally, 1992; Kukla, 1992 ; Kirschner, 2006). This happened, in
32
33 our opinion, because the concept of scientific pluralism has been mistaken for the unrestrained
34
35 proliferation of perspectives. As it has been recently proved, this uncontrolled proliferation risks
36
37 being harmful to scientific integrity and progress (Baliatti, Mäs, & Helbing, 2015).
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The current study

45
46 The aim of our study has been to take a “picture” of the core-concepts of psychology and to
47
48 consequently attest the way that they are commonly conceived and explained in introductory books,
49
50 in order to attempt an “epistemological assessment” of the discipline.
51
52
53

54
55 This has been pursued through an examination of 11 popular introductory textbooks of
56
57 psychology published between 2012 and 2019 and the APA dictionary of psychology (VandenBos,
58
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2015)⁴. Every concept's definition has been carefully researched along with the introductory textbooks and the dictionary, and it has been reported in tables (A1-A6) along with the page it is presented upon, the authors and, when needed, the additional references made by the authors themselves.

The analysis of the introductory books has been chosen because, as written by Staats (1999, p.5) about controversies about a unifying theory, “(...) specialists in the various fields consulted and used only works in that specialty. The only books that treated the several fields of psychology were introductory psychology texts”. In our opinion, this situation seems to be unchanged. Furthermore, Fanelli (2010, p.2) explicitly states that “the core [of research] is (...) identifiable with the content of advanced university textbooks (..)”.

In the philosophy of science, the analysis of introductory textbooks has historically been an accessible tool used to roughly assess the state of a discipline (Cole, 1983, 1996, 2001). This analysis is extraordinarily still used today by many psychologists with either epistemological, educational or political aims and focuses (e.g. Roeckelein, 1996, 1997; Zechmeister & Zechmeister, 2000; Habarth, Hansell & Grove, 2001; Simonton, 2004, 2006⁵; Costa & Shimp., 2011; Kissee, Isaacson & Miller-Perrin, 2014; Griggs & Christopher, 2016; Whaley, Clay & Broussard, 2017; Whitehead III, Smith & Losonczy-Marshall, 2017; Ferguson, Brown, TorresBrown & Torres, 2018; Warne, Astle & Hill, 2018). The analysis of introductory books has also been implemented by scholars from other sciences, including informatics (McMaster, Rague, Sambasivam, & Wolthuis, 2019), statistics (Ravinder & Misra, 2016; Dunn, Carey, Farrar, Richardson & McDonald, 2017), chemistry (Nelson, Kumar & Ramasamy, 2015), biology (Colosi, 2000; Bednekoff, 2005; Wright, Cardenas, Liang & Newman, 2017) and sociology (Manza & Van Schyndel, 2000; Keith & Ender,

4 Someone could argue for the exclusion of influential sources, both due to their historical importance (e.g. William James, Wilhelm Wundt, John Watson...) or due to their specialization in specific psychological sub-disciplines (e.g. Noam Chomsky, Burrhus Skinner in language studies, Jaak Panksepp and Antonio Damasio in emotion studies). However, such criticism would not adequately consider the organizing rationale adopted here. Our interest lies in what is the “core - knowledge” of contemporary psychology operationalized in popular (and recent) introductory textbooks.

5 In Simonton's studies, the analysis of introductory books is just one part of a wider procedure.

2004; Shin, 2014).

Method

Firstly, we examined the definitions of the following fundamental terms:

1. psychology
2. mind
3. behavior

The selection of further psychological core-constructs was based on the category of “*cognitive functions*”. “Cognitive functions” are, in fact, often the main objects of study of scientific psychology. However, since there is no clear definition of cognition (see Table A2), we failed to find a specific list of cognitive functions anywhere ⁶. We therefore adopted the wider meaning of cognition, “information processing in the brain” (Zimbardo, Johnson & McCann, p.190).

A list of cognitive functions is presented below. If their exclusive selection is no doubt somewhat arbitrary, all these terms are usually grouped under the umbrella-term “cognitive functions” (Newell, 1994, p.15; Reisberg, 2013, p.3-5; Ochsner & Kosslyn, 2013, p.7-8)⁷.

4. attention
5. cognition
6. consciousness
7. decision-making
8. intelligence

⁶ Even when they are classified in “higher” and “lower” [the latter being more automatic and reflex-type than the former, requesting an “effortful” process (Frith & Dolan, 1995)], no clear list is presented.

⁷ “**Intelligence**” and “**language**” are two atypical concepts: they cover broader phenomena than those strictly grouped under the label “cognitive functions”. *Language* is sometimes conceived as a full-fledged cognitive function (e.g. Newell, 1994, p. 441; Ochsner & Kosslyn, p.7) and sometimes it is not, but is nevertheless considered as strongly related to cognitive functioning (e.g. Reisberg, 2013, p.2). Intelligence is a wide concept, often assumed to underlie most cognitive process, or, more specifically, to be a sort of general “cognitive ability” (Bernstein et al., 2012, p.373), a varying potential of cognitive processing. Also, in this case, its close conceptual relatedness to the “cognitive functions” accounted for its inclusion in this list. For conceptual clarity and exhaustiveness, we included also the term “**cognition**” itself, even if of course it is not directly cited by these authors (because it is implicitly assumed to be the umbrella-term under which all these concepts are grouped).

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1 9. language

2
3 10. learning

4
5
6 11. memory

7
8 12. perception

9
10 13. problem solving

11
12 14. reasoning

13
14
15 15. thinking

16
17
18 Though they are not usually considered “cognitive functions”, in the end we included the terms due
19
20 to their importance in everyday psychology:

21
22
23 16. emotion

24
25 17. motivation

26
27
28 18. sensation

29
30 Problems arising in the analysis of the specific concepts (e.g. the subdivision of memory into
31
32 working memory, long term memory and short-term memory) have been described table by table.

33
34 All the tables are presented in Appendix A, while a summary is included in the results section.

35 36 37 38 39 40 **Results**

41
42 Below are the main definitions of core concepts in psychology highlighting the main
43
44 elements shared by authors and the texts we selected (for all details, see Appendix A).

45
46
47 **Psychology** is literally defined by most introductory books (7/12) as the “**scientific** study
48
49 of **mind** and **behavior**”. The remaining definitions are substantially similar, despite the fact that
50
51 “mind” is indicated through synonyms (e.g. “mental processes”, “thought”, “cognitive processes”)
52
53 (3/12). Finally, in two definitions “mind” and “behavior” are listed along with the term “brain” or
54
55 “brain processes”. As “mind” and “behavior” are transversely mentioned as the two pillars of
56
57 scientific psychology, it follows that they must be the next elements to be analyzed.
58
59

60
61 **Mind** is not defined by *half* of the introductory books. Four sources define it as a list of

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1 **activities** (e.g. thinking, remembering, feeling...). Two bibliographic sources define it as “**brain**
2 activity” or “brain and behavior”.
3
4

5 **Behavior** is not defined by half of the introductory books. The other sources define it
6 globally as **something that can be directly observed**, but it is not clear whether it is intended as
7 “overt” (external actions), “covert” (internal “actions”, such as an action potential), or in both the
8 meanings. Then, our analysis focused on the so-called “cognitive functions”, presented here in
9 alphabetical order.
10
11

12 (Selective) **attention**: its definitional core seems to converge on the concept of “**focus of**
13 (restricted) **cognitive resources**”, but the definitions vary widely, often referring to “mental
14 processes”, “conscience”, “awareness” or “perception”. Four sources do not define the
15 phenomenon.
16
17

18 **Consciousness**, along with intelligence, is one of the most debated terms in psychology.
19 Definitions largely vary, but ten out of the twelve sources *tautologically* define consciousness as
20 “**awareness**”, one vaguely defines it as the “the brain process that creates our mental
21 representation” and finally one source does not define it.
22
23

24 **Cognition** is so variously formulated that it is difficult to summarize its definitions.
25 Broadly, cognition seems to be an “**umbrella-term**” under which all the activities traditionally
26 considered to be “*cold cognition*” are grouped: e.g. **information processing, thinking, reasoning,**
27 **problem solving, understanding, knowing**. Two sources consider the cognition as a mere
28 *synonym* of “**thinking**” and three sources do not define it.
29
30

31 **Decision-making** is not defined by seven sources. The remaining five sources seem to
32 converge on the process of “**selecting among different alternatives**”, but often referring to other
33 phenomenon like “cognition”, “cognitive processes” or “evaluation”.
34
35

36 **Intelligence** is probably one of the most debated terms in the history of psychology.
37 Definitions (10/12) are so rich and different that summarizing them is nearly impossible, but they
38
39

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1 almost all systemically refer to other psychological constructs (e.g. **reasoning, understanding,**
2
3 **problem-solving...**) Two sources do not define the construct.

4
5
6 **Language** is variously defined, but almost all the definitions seem to converge on the
7
8 manipulation of “**symbols**” (which are not defined) “**combined**” via a “**set of rules**” in order to
9
10 “**communicate**” (“communication” is also scarcely defined). The content of the communication is
11
12 indicated as “thoughts”, “feelings”, or “ideas”. One source does not define language.
13
14

15
16 **Learning.** All the definitions seem to converge on the “**modification**” of “**behavior**”,
17
18 “**mental processes**” or “**information**” of an individual through “**experience**” (which is never
19
20 defined).
21

22
23 **Memory.** Most of the definitions seem to converge on the “**ability**” (or “capacity”) to
24
25 “**acquire information**”⁸, to “**retain**” it “**over time**” and to “**retrieve**” it if needed. Two sources do
26
27 not define memory.
28

29
30 **Perception:** All its definitions seem to converge on the “**mental interpretation**” (which is
31
32 never defined) of “**sensations**”.
33

34
35 **Problem-solving** is not defined by five sources. The concept of “**goal**” is given different
36
37 meanings including “**use of information**”, “**cognitive processes**”, “**thinking**”, “**behavior**”,
38
39 “**reasoning**”, “**higher mental functions**” and “**active efforts**”.
40

41
42 **Reasoning** is not defined by six sources. The remaining definitions largely vary so that it is
43
44 impossible to summarize them. What seems to emerge is a sort of “abstract” and “logical” process
45
46 compared to problem-solving, which seems to be more pragmatic in its nature.
47

48
49 **Thinking** is a widely used term but in our opinion, is still vague. Five sources largely vary
50
51 but converge on the concept of “(mental) **manipulation**” of “(mental) **representations**” (which are
52
53 never defined). A lot of concepts are listed along with them, such “cognitive processes”,
54
55 “information”, “inferences”, “conclusions”, “ideas”, “images” and “scripts”. One source defines it
56
57
58
59

60
61
62 ⁸ “information” is never defined in this case and in the following ones.
63

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1 very vaguely as “any mental activity or processing of information”. Five remaining sources do not
2
3 define the phenomenon. One last one merely defines it as a synonym of “**cognition**”. Finally, we
4
5 focused our analysis on three terms that are very important in everyday psychology: emotion,
6
7 motivation and sensation.
8
9

10 **Emotion** is so variously defined that is very difficult to summarize. Some characteristics
11
12 seem nevertheless to emerge (physical arousal, positive or negative experience, stimulus-related
13
14 phenomenon, response behavior and cognitive appraisal), but they are so unequally considered from
15
16 definition to definition that it is impossible to declare them as defining features.
17
18

19 **Motivations** are variously defined. Nevertheless, the definitions seem to converge on the
20
21 concepts of “**drive**” (or “**influence**”, “**force**”, “**urge**”, “**factor**”, “**need**”, “**desire**”, “**disposition**”,
22
23 “**impetus**” or “**cause**”) to direct “**behavior**” (or “**activities**” or “**actions**”) toward a “**goal**” (or
24
25 “**purpose**”, “**needs**” or “**psychological wants**”). It is therefore not clear if motivations are based on
26
27 “causes”, on “purposes” or on both, but this controversy is probably more philosophical than
28
29 psychological.
30
31
32
33
34

35 **Sensation**. All its definitions seems to converge on the “**stimulation**” of the “**sense organ**”
36
37 or “**sense receptors**”.
38
39

Discussion

40
41 As reported in all tables included in this work, the lack of consensus about the core-
42
43 constructs of psychology is ubiquitous. Analogous considerations about the unsatisfactory nature of
44
45 definitions of constructs have already been made in sociology (Wallace, 1988). However, a coerced
46
47 imposition of definitions would probably change nothing “unless the consensus on the meaning and
48
49 significance of the concepts was real and natural” as written by Cole, again about sociology (1994,
50
51 p.137). Cole's claim probably stems from the fact that a consensus in formulating constructs cannot
52
53 be reached if no paradigm is shared between the formulators (i.e. if they do not “filter” the world
54
55 through the same “lenses”, resulting in a “real and natural” “consensus”). We think therefore, that a
56
57 consensus could be reached by embracing a theoretical framework (Royce, 1987). We do not share
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1 the ideas that unifying psychology is a more “disciplinal maneuver” than an “epistemological act”
2
3 (Stam, 2004), that it can be unified albeit in a “multi-paradigmatic” way (Sternberg, 2001); that it
4
5 can be unified via “inter-field” and “inter-level” theories (Staats, 1991) or that it is destined never to
6
7 be unified (Koch, 1993). In our opinion, the unification attempt might be successful as long as
8
9 different scientists would *not disagree* on the “core” concepts main structures and functions.
10
11

12
13 In this regard, we believe that the most compelling candidate to try and fix this gap is
14
15 *evolutionary psychology*: it may be designed to address the demands reported above in the most
16
17 comprehensive way.⁹ In fact, evolutionary psychology, in line with evolutionary biology, tries to
18
19 answer Tinbergen's (1963) “four questions”: 1) *mechanism*: “What is the structure of the trait; how
20
21 does it work?” 2) *ontogeny*: “How does the trait develop in individuals?” (Nesse, 2013, p.681) 3)
22
23 *phylogeny*: “What is the system’s history? How has it changed through evolution, and how does it
24
25 differ between related species?” and 4) *adaptation*: “Why did the system evolve into its present
26
27 form? What evolutionary advantages did it provide?” (Del Giudice, 2018, p.42). The answers to the
28
29 first two questions are usually labeled as *proximate* because they explain how an “organism works
30
31 in present” (Del Giudice, 2018, p.42). The answers to the third and fourth questions are labeled as
32
33 *ultimate* because they explain how an organism reached its current biological functioning from a
34
35 “historical” perspective.
36
37
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42
43 *Ultimate* and *proximate* explanations are complementary; together, they can offer a
44
45 satisfactory explanation about the whole functioning of psychological mechanisms. Nevertheless,
46
47 the typical approach in medicine and psychology is to focus exclusively on the proximate ones (Del
48
49 Giudice, 2018). Evolutionary psychology could thus be the most complete approach because it is
50
51 the only one that manages to integrate answers to all four questions. Furthermore, it dissolves the
52
53 long-standing debate of nature vs nurture and it is a credible bridge between scientific and clinical
54
55

56
57
58 9 Henriques (2017) claimed that “every major perspective in psychology currently accepts evolutionary theory”
59 (p.393), treating it as a simple theory and not as a meta-theory, which according to him is something different and
60 can be represented in his “Tree of Knowledge” (Henriques, 2003). We disagree with Henriques both in regard to the
61 “acceptance” of evolutionary theory in the context of psychology and in regard to the consideration of evolutionary
62 psychology as a theory, while we explicitly claim that it is a meta-theory.
63

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1 psychology, which manages to connect in a continuum of *normal vs abnormal* functioning, offering
2
3 a compelling explanation for many mental disorders (Nesse, 2015; Brüne, 2015; Del Giudice,
4
5 2018). Some critical points must be addressed before this issue is analyzed more thoroughly.
6
7

First critical aspect: is it any different in the so-called “harder” sciences?

8
9
10 One could argue whether this conceptual vacuum is also present in other sciences. It is
11
12 widely accepted that the scientific inquiry is a process of constant reviewing and redefining of its
13
14 constructs (Kuhn, 1970), so a similar situation could be evidenced in other branches of knowledge.
15
16 However, there seem to be different degrees of “uncertainty” varying from one science to another.
17
18 This has been defined by many as the contrast between “hard” and “soft” sciences.
19
20
21

22 What is meant by “hard” science? There is no univocal definition, though, the key idea is that hard
23
24 sciences typically show a larger *consensus* in their “core” [the “core” is “the corpus of agreed upon
25
26 theories and concepts that researchers need to know in order to contribute to the field” (Fanelli,
27
28 2010, p.2)] (Zuckerman & Merton, 1972; Cole, 1983, 1994; Simonton, 2006; Fanelli, 2010; Fanelli
29
30 & Glänzel, 2013). Furthermore, hard sciences seem to prove a stronger capacity to accumulate
31
32 knowledge, relying more “on the significance of new knowledge and the continuing relevance of
33
34 old” (Fanelli & Glänzel, 2013, p.1; Simonton, 2002).
35
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38

39 By contrast, *soft* sciences seem to have less consensus in their core, a minor capacity to
40
41 accumulate knowledge and a minor adherence to the data and theories, who “speak less from
42
43 themselves” and are more likely to be influenced by non-cognitive factors, such as the academic
44
45 prestige, political and ideological beliefs, and so on (Fanelli & Glänzel, 2013). There is no
46
47 qualitative difference, rather a “graduation” between these two “groups” (Fanelli & Glänzel, 2013).
48
49 This contrast, recently seen as “controversial, if not even offensive”, nevertheless seems “to capture
50
51 an essential feature of science” (Fanelli, 2013, p.1).
52
53
54
55

56 Psychology is both historically (Simonton, 2004) and contemporarily (Fanelli, 2010;
57
58 Fanelli & Glänzel, 2013) considered as “soft” when compared to “hard” sciences such as physics,
59
60 biology or chemistry. These sciences are often compared to psychology theoretically and
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62

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1 practically (Popper, 1972; Lilienfeld, 2014); moreover, they are more frequently believed to be
2
3 “stronger” than psychology both by lay people and by scholars (Janda, England, Lovejoy & Drury,
4
5 1998). In order to assess if this difference in “hardness” is real, we conducted a comparison between
6
7 the psychological science and these three sciences (physics, biology, chemistry).
8
9

10 Ideally, two considerations, respectively labeled synchronic and diachronic, must be
11
12 addressed in order to draw the comparison. First, it must be examined whether, within a specific
13
14 time interval (often the most recent), the degree of “hardness” in physics, biology and chemistry is
15
16 meaningfully different than the one in psychology [synchronic]. Second, it must be examined
17
18 whether, along with the scientific progress evolving over time, the “significance of new knowledge
19
20 and the continuing relevance of old” is really different between psychology and these other three
21
22 sciences [diachronic].
23
24
25
26

27 *A synchronic point of view.* The first question seems to have been answered by empirical
28
29 literature, which, by using sophisticated bibliometric and statistical methodologies, has empirically
30
31 demonstrated what only used to be a conceptual speculation (Simonton, 2002, 2004; Fanelli, 2010;
32
33 Fanelli & Fanelli & Glänzel, 2013). Simonton's first paper (2002) is an attempt to summarize a
34
35 “systematic statistical comparison” (Simonton, 2002, p.352) of all previous research conducted in
36
37 the “epistemological assessment” of the hierarchy of sciences, in order not to “to address the
38
39 substantive question piecemeal” but rather to get a global reliable index. For example, different
40
41 studies previously conducted dealt with different disciplines. Also, the “various alternative rankings
42
43 of the sciences” had “not [been] subjected to any rigorous statistical test of the degree to which they
44
45 might be in agreement” (Simonton, 2002, p.352). The disciplines considered in this study were
46
47 physics, chemistry, psychology and sociology. With such a rigorous methodology, the parameters
48
49 considered in this study have been:
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51
52
53
54
55

56 **1.Theories-to-laws ratio.** “Roeckelein's (1997) measure called “theories-to-laws ratio”
57
58 (number of cited theories divided by number of cited laws in textbooks). (...) The ratio will be well-
59
60
61
62

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1 balanced, i.e., show low values, for the "natural" sciences (physics, chemistry, biology) and be
2
3 poorly balanced, i.e., show high values, for the "social" sciences (anthropology, sociology)"
4
5 (Roeckelein, 1997, p. 131). The higher the ratio, the higher the "softness".
6
7

8 **2. Consultation rate.** Suls & Fletcher (1983) index, based on Leon Festinger's (1954)
9
10 social comparison theory. In a nutshell, the consultation "with colleagues before submitting a paper
11
12 for publication in the discipline's journal (...), revealed in the acknowledgment sections of the
13
14 published articles" (Simonton, p.351) is assumed to reflect the uncertainty about core topics of the
15
16 discipline. "The specific measure was the number of persons acknowledged adjusted for the number
17
18 of authors" (Simonton, 2002, p.352). Similar to the previous index, the higher the ratio, the higher
19
20 the "softness".
21
22
23

24
25 **3. Early impact rate.** All the remaining criteria came from Cole (1983). The first is the
26
27 "proportion of scientists under 35 whose work received more than the mean number of citations for
28
29 their field" (S. Cole, 1983, p. 118; i.e., fields that incorporate most quickly the work of young
30
31 scientists are assumed to rank higher in the hierarchy) " (Simonton, 2002, p.354).
32
33
34

35 **4. Peer evaluation consensus I.** The fourth criterion is supposed to evaluate consensus, i.e.
36
37 "the "consensus on evaluating scientists by field" (S. Cole, 1983, p. 120), where 60 scientists per
38
39 field were rated by colleagues in the same discipline (the consensus was gauged by the mean
40
41 standard deviation of the ratings)".
42
43
44

45 **5. Peer evaluation consensus II.** The fifth criterion is supposed to evaluate the consensus as
46
47 well, i.e. "the consensus gauged by asking scientists to mention those who "have contributed the
48
49 most in past two decades" (S. Cole, 1983, p. 120; the specific index is the percentage of "mentions
50
51 received by 5 most mentioned names").
52
53
54

55 **6. Citation concentration.** The "concentration of citations to research articles" (S.
56
57 Cole, 1983, p. 122; using the Gini coefficient) (Simonton, 2002, p.354). "If the citations are all
58
59 concentrated in a single article, then the disciplinary consensus must be very high, whereas if it is
60
61
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63
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1 more evenly distributed across articles, then the consensus must be minimal” (Simonton, 2002,
2
3 p.353).
4

5 The overall results (for further detail, see Simonton, 2002) confirmed the “soft” status of
6
7 psychology compared to physics and chemistry.
8
9

10 Simonton's second paper (2004) is aimed at replicating and expanding the former study. It
11
12 deals specifically with physics, chemistry, biology, psychology and sociology. Two further primary
13
14 criteria have been added to those mentioned above:
15
16

17
18 **1. The *obsolescence rate*** by McDowell (1982). “On the basis of the relative frequency of
19
20 citations to older publications, McDowell (1982) determined the rate at which knowledge becomes
21
22 obsolete for the disciplines (...) The specific measure used here was his calculation of the expected
23
24 publication cost of interrupting a career for just 1 year. (...). For example, if their career is
25
26 interrupted for a single year (e.g., by administrative work or parental or health leave), the output of
27
28 physicists will be cut by about 17%, whereas the productivity of psychologists will be cut by about
29
30 10% (because physicists will have much more “catching up on the literature” to do before they can
31
32 resuscitate their careers) (Simonton, 2004, p.61).
33
34
35
36

37
38 **2. *Graph prominence*:** “Cleveland (1984) assessed the extent to which graphs appear in
39
40 articles published in the professional journals, demonstrating that graphs are more extensively used
41
42 in the “hard” disciplines (see also Smith et al., in press).”
43
44

45 The *peer evaluation consensus II* was removed due to methodological issues. Other
46
47 “secondary measures” are considered, even if not essential for the main statistics because they are
48
49 not completely objective but nevertheless they are “useful for validating the results obtained from
50
51 the primary measures” (Simonton, 2004, p. 62)¹⁰. The results demonstrated that Psychology is
52
53 “softer” than the traditional “harder” sciences according to these parameters.
54
55
56

57 Fanelli's first study (2010) focused on the “confirmatory bias”. In other words,
58
59

60
61 ¹⁰ *Lecture disfluency, Citation immediacy, Anticipation frequency, Age at receipt of Nobel Prize, rated disciplinary*
62 *hardness* (for further details, see Simonton 2004).
63

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1 “researchers in “softer” sciences should have fewer constraints to their conscious and unconscious
2
3 biases, and therefore report more positive outcome” (Fanelli, 2010, p.1). This study includes a
4
5 broad range of sciences, including physics, chemistry, biology and psychology. The results are
6
7 clear: “the odds of reporting a positive result were around 5 times higher among papers in the
8
9 disciplines of Psychology and Psychiatry and Economics and Business compared to Space Science,
10
11 2.3 times higher in the domain of social sciences compared to the physical sciences, and 3.4 times
12
13 higher in studies applying behavioral and social methodologies on people compared to physical and
14
15 chemical studies on non-biological material”. For further methodological issues, see the original
16
17 paper (Fanelli, 2010).
18
19
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21

22
23 Fanelli & Ganzel’s paper (2013) is more sophisticated. About 30, 000 papers from different
24
25 disciplines (including physics, chemistry, biology and psychology) have been analyzed through nine
26
27 indexes:
28
29

30 **1. Number of authors.** “Research teams are almost by definition built around a consensus
31
32 on objectives and methods. Moreover, the ability to study a problem with greater accuracy and
33
34 detail leads to a specialization of roles, making collaboration essential(...) The hardness of a field,
35
36 therefore, should be manifest in the size of its research teams” (Fanelli & Ganzel, 2013, p.4).
37
38
39

40 **2. Length of article.** “When consensus is lower, papers must put greater efforts in
41
42 describing the background, justify their rationale and approach, back up their claims and
43
44 extensively discuss their findings (...) Longer introductions, and generally longer papers, should
45
46 therefore characterize softer research. We measured the total number of pages” (Fanelli & Ganzel,
47
48 2013, p.5).
49
50
51

52 **3. Number of references.** “For reasons similar to those that make an article longer,
53
54 references to previous literature should also be more numerous in low-consensus fields (...)”
55
56

57 **4. References to monographs.** “Scholars in the humanities and social sciences still
58
59 frequently choose to publish books rather than papers”.
60
61
62

1 **5. Age of references.** “Having noted that some sciences “metabolize” the literature more
2
3 rapidly, Derek de Solla Price (1970) proposed an index, which measures the proportion of cited
4
5 references published in the five years preceding the citing paper. The faster the “metabolism”, the
6
7 “harder” the science.
8
9

10 **6. Diversity of sources.** “When scholars agree on the relative importance of scientific
11
12 problems, their efforts will concentrate in specific fields and their findings will be of more general
13
14 interest, leading to a greater concentration of the relevant literature in few, high-ranking outlets”
15
16 (Fanelli & Ganzel, 2013, p.6).
17
18

19 **7. Relative title length.** “Linguistic analyses of scientific papers noted that the number of
20
21 substantive words in titles tended to be longer and to correlate with an article’s total length in harder
22
23 fields (...). We measured the total number of words, divided by total number of pages.”
24
25
26

27 **8. Use of first person.** “Scientists aim at making universal claims, and their style of writing
28
29 tends to be as impersonal as possible. In the humanities, on the other hand, the emphasis tends to be
30
31 on originality, individuality and argumentation, which makes the use of first person more
32
33 common(...)”
34
35
36

37 **9. Sharing of references.** “Authors that cite a common literature almost by definition are
38
39 exhibiting a common cognitive background. The sharing of references between papers, therefore, is
40
41 perhaps the most direct expression of scholarly consensus. Of the various techniques available to
42
43 analyse citation networks, the most likely to reflect this parameter is bibliographic coupling, in
44
45 which a network link is draw between two papers that cite the same reference(...)” (Fanelli &
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66 Once again, the hierarchy of sciences (with psychology/psychiatry as “soft” sciences) has
67
68 been confirmed (for more detail, see Fanelli & Ganzel, 2013). Psychology, often alongside
69
70 psychiatry, really *seems to be “softer” than physics, chemistry and biology*. As we believe that the
71
72 experimental method applied to philosophy is a valid tool to settle conceptual disputes (Griffiths &
73
74
75

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1 Stotz, 2008; Sytsma & Buckwalter, 2016), we have mainly based our considerations on this
2
3 empirical data. Reasonably, it could be argued that this empirical data is not sufficient to
4
5 exclusively resolve the issue. It could be said, for example, that even the fundamental concept of
6
7 “life” - upon which biology is based (*βίος/bíos*: life; *λογος/logos*: science) - is indeed not
8
9 unanimous, as said by Lilienfeld (2004) against Henriques (2004). In our opinion, this conceptual
10
11 claim does not take into account the broader epistemological context of biology; the latter clearly
12
13 seeming more “solid” than the context of psychology as demonstrated by the studies mentioned
14
15 above. Similar considerations could be made on analogous controversies in physics and chemistry.
16
17
18

19
20 *A diachronic point of view.* The second issue is about the historical discontinuity (“the
21
22 significance of new knowledge and the continuing relevance of old”), or as Simonton (2002, p. 355)
23
24 put it, the “*intra-disciplinary advancement*”. A historical analysis in psychology is inevitably
25
26 preceded by many conceptual problems. First, does the word “paradigm(s)” fit the “schools of
27
28 thought” in a proper sense? The answer is largely controversial, and some authors have fairly
29
30 proposed to use the word “sub-discipline” instead (Friman, Allen, Kerwin, & Larzelere, 1993), a
31
32 suggestion that has been adopted by other studies in this field alongside the term “school” (Robins,
33
34 Gosling & Craik, 1999; Tracy et al., 2005; Norcross, Karpiak & Santoro, 2005; Spear, 2007). Here,
35
36 we will use the word “approach”, “theory” or “trend” because the term “sub-discipline” or “school”
37
38 might implicitly suggest that these views are completely incompatible with each other when they
39
40 are not.
41
42
43
44
45
46

47
48 Consistent with the considerations about the experimental method applied to conceptual
49
50 disputes, we based our commentary only on existing *empirical literature* on “historical trends” in
51
52 psychology (Robins et al., 1999; Tracy et al., 2005; Norcross et al., 2005; Spear, 2007).¹¹ These
53
54 studies assessed the prominence of every theory thanks to particular bibliometric measures;
55
56

57
58 11 Moreover, our focus has been exclusively on these studies because we wanted to avoid the systematic positive
59
60 distortion of a researchers' point of view towards his own theory (Tracy et al., 2005). This bias could potentially affect
61
62 all qualitative historical analysis. Furthermore, empirical analysis appears to be a more intersubjective source than
63
64 qualitative analysis (Simonton 1990, 2006).
65

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1 assuming the more an approach is cited the more it is prominent, they estimate the “citation pattern”
2
3 of every theory and compare one to each other in order to determine what “rises”, what “is in
4
5 decline” and so on.
6

7
8 This stance obviously limited¹² (but also grounded) our conclusions in the period in which
9
10 bibliometric analysis has been done, i.e., after the 1950’s. It has also restricted the analysis of just
11
12 four approaches (psychoanalysis, cognitivism, behaviorism and neuroscience). Spear (2007) also
13
14 considered the neuro-cognitive theory and Norcross and colleagues (2005), whose analysis was
15
16 about clinics, also mentioned the humanistic and integrative/eclectic approaches. Cognitive-
17
18 behavioral theory, gestalt theory, evolutionary psychology, alongside other important approaches
19
20 and historical traditions – e.g. structuralism and functionalism - have been deliberately ignored,
21
22 making our conclusions simpler (and perhaps more simplistic). Furthermore, the approaches have
23
24 been considered in a “monolithic fashion”, while it is widely known, for example, that
25
26 psychoanalysis is subdivided into many different approaches.
27
28
29
30
31

32
33 Despite all these limitations, since the intention was to have an overall idea about conflicts
34
35 between different theories, we believe that such analysis may satisfactorily reach our aim. In
36
37 summary, what emerges from these papers is that the neuro-cognitive approach is undoubtedly the
38
39 most popular nowadays in psychology (Tracy et al., 2005; Spear, 2007). On the other hand, in
40
41 clinical psychology, cognitive and eclectic/integrative approaches appear to be the most
42
43 implemented (Norcross et al., 2005). Although the cognitive approach is a very common and
44
45 shared, it seems to be *far away from* being a real “paradigm”. (Tracy et al., 2005; Spear, 2007).
46
47
48

49
50 A historical comparison with the other sciences is therefore unlikely to be made. No real
51
52 paradigm seems to be identifiable in the “recent” history of psychology (post-1950). It is very likely
53
54 that no real paradigm (in a *kuhnian* sense) existed either in “past” psychology (1879-1950) as many
55
56 suggested (James, 1894; Heidbreder, 1933; Cronbach, 1957). Since no real psychological paradigm
57
58
59
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61 12 These bibliometric indicators have been harshly criticized (Pettit, 2016; Burman, 2018).
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(in a *kuhnian* sense) probably ever existed, it is very difficult to assess if the “intra-disciplinary advancement” is actually different between psychology and physics, chemistry and biology. One empirical study confirms this hypothesis which comes from Simonton's study (2002, p.355), who reanalyzed the theories-to-laws ratio collected by Roeckelein (1997) and showed how this ratio declines as the years pass in physics or chemistry, but rises in psychology, supporting its “softness”.

Finally, addressing the question that started this section, psychology appears to be different from the so-called “harder” sciences. It seems to still dwell in a pre-paradigmatic stage (Kuhn, 1970), in which conflicts between rival schools hamper the development of an original research programme (Lakatos, Worrall & Currie, 1979). This condition has already been “assessed” by many (e.g. Kuhn, 1970; Warren, 1971; Briskman, 1972; Baliani et al., 2015; Melchert, 2016; Goldfried, 2018).

Second critical aspect: is the empirical evidence collected over one hundred years not enough to declare psychology as a science?

The current work aimed at underlining the theoretical precariousness of psychology, not at undermining its scientific status or at denying its important discoveries and results. It is not our intention to question the validity, necessity or importance of this discipline. We are not discussing whether or not psychology is a science. Instead, our focus is on its epistemological status and on the way in which it could become a paradigmatic discipline and not a pre-paradigmatic one. As we have a great interest in the matter, we do hope that with a clearer theoretical framework, a lot of scientific issues could be tackled with more success.

Third critical aspect: why should evolutionary theory be more complete than others? How would it be adopted?

Evolutionary psychology has a lot of criticisms. Its major tenets have been questioned, including its testability, some of its fundamental cognitive assumptions like the massive modularity,

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1 the alleged inconsistency of the notion of EEA (environment of evolutionary adaptation), its
2
3 potential methodological flaws (disjunction and grain problems), its alleged determinism,
4
5 reductionism and the underestimation of the environmental influences, as well as the so-called
6
7 “natural teleology” and the “spandrel” problem (Gould & Lewontin, 1979; Davies, Fetzner & Foster,
8
9 1995; Panksepp & Panksepp, 2000; Fodor, 2001; Lloyd & Feldman, 2002; Gannon, 2002; Franks,
10
11 2005; Buller, 2006; Richardson, 2007; Hamilton, 2008; Machery, 2008; Rose & Rose, 2010;
12
13 Bolhuis, Brown, Richardson, & Laland, 2011; Ward, 2012; Peters, 2013). However, many of these
14
15 criticisms seem to be inconsistent due to theoretical misconceptions, as suggested by many
16
17 evolutionary scholars (Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998; Carruthers, 2003,
18
19 2006; Tooby, Cosmides & Barrett, 2005; Barkow, 2005; Daly & Wilson, 2005; Hagen, 2005; 2015;
20
21 Hagen & Hammerstein, 2005; Delton, Robertson & Kenrick, 2006; Machery & Barrett., 2006;
22
23 Confer et al., 2010; Van Le et al., 2013; Klasios, 2014; Ploeger & van der Hoort, 2015).

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30 Despite the considerable empirical support collected, which can be summarized in recently
31
32 edited handbooks of evolutionary psychology (Barrett, 2007; Buss 2015a, 2015b, 2019) and despite
33
34 the heartfelt claims of unification under its name (e.g. Cosmides, Tooby & Barkow, 1992; Tooby &
35
36 Cosmides, 1992; Buss, 1995; Caporael, 2001; Tooby & Cosmides, 2007; Dunbar & Barrett 2007b,
37
38 Duntley & Buss, 2008; Badcock, 2012; Carmen et al., 2013), this discipline is not *yet* a paradigm in
39
40 the Kuhnian sense ¹³ (Glass, Wilson & Geher, 2012; Burke, 2014).

41
42
43
44 We believe that evolutionary psychology may represent a compelling meta-theory.
45
46 Nevertheless, it is more multifaceted than it is sometimes presented. This approach is indeed often
47
48 mechanically identified with the “EP” or “Santa Barbara School” - led by John Tooby, Leda
49
50 Cosmides, Steven Pinker, David Buss and Donald Symons - and with its own theories (Barrett et
51
52 al., 2014). This trend is often referred to as the *narrow-sense evolutionary psychologists* (Mameli,
53
54 2007)

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56
57
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59
60 ¹³ i.e. an acknowledged and shared major theory and methodology around which minor sub-theories “orbit” (Kuhn,
61
62 1970)

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1 However, within evolutionary psychology, different theories have been proposed, aligned
2
3 to a core-idea that however results in dramatically different assumptions and implications, a
4
5 tendency that may referred to as the *broad sense evolutionary psychology* (Mameli, 2007). To
6
7 testify this pluralism, it is worth noting that some leading evolutionary scholars question the
8
9 computational postulation, the massive modularity hypothesis and the notion of EEA itself,
10
11 concepts upon which the “Santa Barbara School” has been built (Dunbar & Barrett, 2007a, 2007b;
12
13 Stephen, 2014; Barrett et al., 2014; Barrett, Pollet & Stulp, 2015; Stulp, Pollet & Barrett 2015).
14
15 They firmly believe in the evolutionary framework, but they have a somewhat greater consideration
16
17 of the environmental influences. For example, in a recent study, Tomasello (2019) suggested from
18
19 an evolutionary perspective that what makes human *unique* is primarily related to *cultural* and
20
21 *ontogenetic* processes. As regards for the computational criticisms, there is a growing interest in the
22
23 e-cognition or distributed cognition (e.g. Barrett, 2011).
24
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30 Setting aside the specific controversies, what we want to highlight is that evolutionary
31
32 psychology must not be identified as a monolithic school, rather as a core-idea (“our mind and
33
34 behavior are significantly shaped by our phylogenetic history”) that can be variously addressed.
35
36 What is fiercely debated concerns specific theories and methodologies: almost no-one would deny
37
38 that we are animals biologically designed to survive and reproduce.¹⁴ Most of the critics of
39
40 evolutionary psychology recognize that its core principle is credible (Hagen, 2015).
41
42
43
44

45 However, “the contested nature of evolutionary psychology lies not in our status as evolved
46
47 beings, but in the extent to which evolutionary ideas add value to studies of human behavior, and
48
49 the rigor with which these ideas are tested” (Barrett, Pollet & Stulp, 2014, p. 1). Fodor (2001)
50
51 advised in this regard that no scientific field, even if logically intriguing, could be valid *a priori*; the
52
53 only legitimate criterion is the empirical evidence (*a posteriori*). He argues (Fodor, 2001, p.83) that
54
55 there is no pure logical reason constraining the mind and brain to follow the same evolutionary
56
57
58

59 14 Such statements must be interpreted with caution: the biological design does not imply a reductionistic view
60
61 of the mind and the main evolutionary aim (reproduction) must be intended not in an overly intuitive manner (Pinker,
62
63 1997).
64

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1 processes which designed the other organs of the body. Similarly, Fodor goes on, there is no
2
3 necessary link between “lunar geography” and “cellular mitosis”, even if both can be claimed as
4
5 scientific phenomenon. We find this argument logically consistent but pragmatically inconsistent.
6
7 Adopting an “Occam's razor” reasoning, we object that there seems to be a far greater
8
9 “epistemological distance” between lunar geography¹⁵ and cellular mitosis than the one occurring
10
11 between the mind-brain system and the rest of the body.
12
13

14
15 Despite its limitations, evolutionary psychology's global theoretical consistency (which
16
17 cannot determine its scientific success alone anyway) cannot be ignored (Wilson, 1999). It is linked
18
19 directly to biology, through which it can be connected to the other “hard” sciences. It is compatible
20
21 with – and somewhat built on – neuro-cognitivism, and finally it is consistent with other
22
23 psychological sub-disciplines (e.g. developmental, social, personality and psychopathology) and
24
25 with other disciplines and sciences, like anthropology (Barrett, 2007; Buss 2015a, 2015b).
26
27

28
29 A great unresolved issue stands in our way to a theoretical and practical resolution. What
30
31 about the other “schools of thought”? What about psychoanalysis, Gestalt, systemic, humanistic
32
33 theory and positive psychology (just to note a few...)? Can they co-exist with evolutionary
34
35 psychology? Can they maintain their identity? If evolutionary psychology proves itself as a meta-
36
37 theory, will they be “cannibalized”¹⁶? The matter is the most important; here probably lies the very
38
39 nature of the problem.
40
41
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45 We explain below why evolutionary psychology seems to prove itself as the most all-
46
47 encompassing approach. Historically, every psychological school posited a “drive” or a “aim” at the
48
49 very heart of the whole psychological functioning. Melchert (2016, p. 488) labeled it as the “*first*
50
51 *principle*”. For Freudian psychoanalysis, this has been the fulfilment of a “drive” (*Trieb*, in
52
53 Deutsch), for Jung, it was the process of *individualization* – and similarly, every psychodynamic
54
55 author has its own name and related theory. The same happens in other schools of thought as well:
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57
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61 15 Upon which soil no trace of life has been found

62 16 Adopting a colorful metaphor by E.O Wilson, quoted in Buss (2019, p.39)

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1 systemic theory, for example, posits that an individual cannot be separated from his familiar
2
3 context, which is in turn seeking *homeostasis*. Rogers, often regarded as the “father” of humanistic
4
5 theory, stated that every individual ultimately seeks *self-actualization*. This is a rough and simplistic
6
7 summary, since is not our intention to make a list of all the different “*first principles*” by different
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9 schools. What we want to stress here is that every psychological school posits *universal* and *inborn*
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11 tendencies in every individual, which are obviously shaped by the environment in which they
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13 unfold. This *first principles* are *universal* and *inborn* tendencies, axioms through which all the
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15 theoretical and practical corollaries of the given school develop. Without the fulfilment of the drive,
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17 there would be no place in Freudian psychoanalysis for “higher” theories (e.g. dream interpretation,
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19 transference, psychosexual development, Oedipus complex, Eros and Thanatos etc.), or specific
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21 techniques (e.g. interpretation, confrontation, working through etc.) Similarly, in all the other
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23 schools, all theory and practice is eventually related to a *first principle(s)*, which is *universal* and
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25 *inborn*.
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33 We claim that evolutionary psychology is precisely the most compelling theoretical and
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35 empirical effort to frame these *universal* and *inborn* tendencies (*nature*). It is also the most
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37 compelling approach to frame the environmental influences intervening in shaping these tendencies
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39 (*nurture*). In this regard, this approach could be based on two theoretical foundations, one nested in
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41 each other. The first foundation (*nature*) seems to clearly be the *process of natural selection itself*,
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43 which poses evolutionary psychology directly in connection with evolutionary biology. The natural
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45 selection chooses which components are part of human (and non-human) *innateness*. There are
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47 some controversies about the actual “unit” upon which natural selection acts, but one of the most
48
49 popular and widely accepted theory today is the *gene-centered view of evolution*; commonly known
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51 as the “selfish gene” theory by Richard Dawkins (Dawkins, 2016). According to Dawkins (and to
52
53 many biologists that endorse this theory) the selection process does not act on individual organisms
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55 or species, rather, it acts on genes. The word “gene” is so important that it must be clearly defined.
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1 As explicitly stated by Dawkins, the word “gene” is used “in a special sense, tailored to evolution
2 rather than embryology” (...) “A gene is defined as any portion of chromosomal material that
3 potentially lasts for enough generations to serve as a unit of natural selection” (Dawkins, 2016,
4 p.754). Epigenetic variations are comprehended as well, because it is demonstrated that they are
5 heritable and can be selected in the evolution process (e.g. Del Giudice, 2018). Genes are
6 expressed in phenotypes, but the latter are merely genes' “vehicles”. To summarize, evolutionary
7 speaking, it is almost all about genes trying to replicate themselves to become “immortal”¹⁷.

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18 Complex phenomena like intra-genomic conflict and inclusive-fitness theory find their natural
19 explanation in the Dawkins theory ¹⁸. Of course, the *gene-centered view of evolution* view has been
20 criticized (e.g. Gould, 1997). Furthermore, complementary and partially different explications have
21 been proposed, like the *multilevel selection theory* (e.g. Nowak, Tarnita & Wilson, 2010) which has
22 been harshly criticized by a paper signed by 137 biologists (Abbott et al., 2011). Even if the
23 controversies are far from dissolving, the consensus on the *gene-centered view of evolution* seems
24 the mainstream theory in the contemporary evolutionary biology, so we will stick with it.

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35 However, a *naive application* of the “selfish gene” theory to human mind and behavior to
36 frame our “innateness” would lead us to unforgivable mistakes. Thanks to the “*seed bank paradox*”,
37 we can easily grasp the *conceptual gap* between a naive application of the “selfish gene” theory in
38 psychology and the actual evolutionary process that seems to be in play. For example, if the
39 ultimate goal of an individual is to spread their genes, one could assume (*naive application*), that
40 the males living in our contemporary society should feel the urge to donate their sperm to a seed
41 bank in order to spread their genes at a dramatically higher rate than the one achievable through
42 simple mating. Of course, this does not happen. The answer to this paradox, Steven Pinker (1997,
43 p.44) wrote is that “Sexual desire is *not* people's strategy to propagate their genes. It's people's
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58 ¹⁷ Dawkins himself noted (2016, p.13) that “immortal gene” would had been probably a better title than “selfish
59 gene”.

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61 ¹⁸ These complicated processes are here only mentioned for the sake of brevity. The reader may find further details
62 elsewhere (e.g. Dawkins, 2016)

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1 strategy to attain the pleasures of sex, and the pleasures of sex are the genes' strategy to propagate
2 themselves.” In other words, evolution selected the genes that code for sexual *lust*, that in turn was
3 a “genes' strategy to propagate themselves”. It is the lust, and not a cumbersome psychological
4 mechanism such as the “urge to donate to seed bank”¹⁹ that human beings want to experience. A
5 first important divisor must therefore be drawn between the behaviors' “aim” and genes' “aim”.²⁰
6 Behaviors are shaped by genes' “perspective”²¹, but they cannot completely be reduced to them.
7 Here, the second foundation of evolutionary psychology is relevant; what makes our human mind
8 and behavior *unique* (Tomasello, 1999, 2019). What shaped the human specific psychology in our
9 environment of evolutionary adaptation? The *social brain hypothesis*, popularized by the British
10 scholar Robin Dunbar (1998, 2009) seems to successfully answer this question. Along with other
11 fundamental adaptations (e.g. problems of survival, problems of sex and mating and problems of
12 parenting and kinship), our *Homo Sapiens* species seems to distinguish itself due to the importance
13 that the *social* environment has as a selective pressure to shape our psychological functioning
14 (Dunbar 1998, 2009).²² We are, in Tomasello's words (2014), an “ultra-social” animal, the most
15 socially competent species on the planet. We can co-operate in complex ways, “read” other
16 “intentions” (what is often called as “theory of mind”), communicate through a public language,
17 share our attention, etcetera (Tomasello, 1999, 2009). What is crucial here is that our *social*
18 *competence* is ultimately permitted by our biological functioning. In a nutshell, *we are naturally*
19 *selected to be cultural*. At the same time, our cultural life has a biological impact on us; *we are*
20 *culturally shaped in our nature*.

21 This evolutionary explanation seems to make sense to our extraordinary sensitivity to social

22 19 The “seed bank” is a very recent cultural introduction and could not be targeted by the genes in so little evolutionary
23 period to develop a psychological mechanism.

24 20 The word “aim” is used in a deliberately metaphorically fashion, we do not imply teleology for genes.

25 21 It is absolutely necessary to stress the fact that we are adopting again metaphorical language. Genes actually do not
26 “reason”, “plan” or “make strategies”, but we could easily grasp conceptually their “behavior” through these
27 mentalistic metaphors.

28 22 Of course mating, parenting and kinship are *social* processes themselves, but they are more common in the animal
29 kingdom than the specific *Homo Sapiens*' social competence, which seems to have being triggered by *group living*.
30 It is likely that this competence has influenced the process of mating, parenting and kinship, according to a circular
31 causality process.

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1 signals and to our vulnerability to mental disorders, which characterize themselves very often as an
2
3 impairment in “social participation” (APA, 2013).
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6 All that being said, evolutionary psychology *really* seems to prove itself as a compelling
7
8 meta-theory. It fully accounts both for our innate and universal nature and for the crucial role of our
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10 social environment. It can explain both our universal nature and our personal individuality, because
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12 it accounts for our high plasticity to our environment, since we are biologically “wired” to collect
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14 environmental signals (which in turn can influence our biology). Eventually, it explains why we are
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16 so vulnerable to mental disorders. The study of the power of the gene-relatedness in our behavior is
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18 now largely attested (e.g. Buss, 2019). More importantly, the “innateness” of evolutionary
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20 psychology is *biologically and empirically* based, it is not drawn from speculation or from clinical
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22 observations. At the same time, the social brain hypothesis is in harmony with the clinical
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24 observations made by systemic, Gestaltic, and intersubjective schools (just to note a few...). It
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26 furthermore explains, along with other complex psychological mechanisms (e.g. Del Giudice, 2018)
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28 our abnormal functioning.²³. In another words, evolutionary psychology really seems to be the most
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30 complete and multifaceted approach to comprehend human (and non-human) psychological
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32 functioning.
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Conclusion

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41 An analysis of “core-concepts” in psychology (showing unsatisfactory and discordant
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43 definitions) and a comparison to “harder” sciences (physics, physics, chemistry and biology)
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45 appeared to demonstrate the “soft” nature of psychology and its pre-paradigmatic condition.
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47 Evolutionary psychology has been suggested to be the most compelling candidate to possibly
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49 overcome this epistemological impasse.
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54 Obviously, there are many limitations to the considerations we proposed here. First, the
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56 empirical papers on which we have based our epistemological comparison are not numerous, and
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61 ²³ Finally, integrative attempts have been made with psychoanalysis as well (e.g. Nesse, 1990; Walters, 1994; Migon e
62 & Liotti, 1998; Marcaggi & Guénolé, 2018)

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1 they should be replicated in more recent times (especially the papers about the “historical trends” in
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3 psychology, which also considered the schools in a “monolithic fashion”). Furthermore, someone
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5 could more generally question the empirical validity of these analyses from a methodological point
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7 of view. In addition, the selection of the sample of introductory books and the “core-constructs”
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9 could be questioned as somewhat arbitrary. Finally, the claim of unification under the name of
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11 evolutionary could be seen as ideological.
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15 Nonetheless, we believe that our conclusions and main arguments remain robust. Even if
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17 the “empirical” papers about conceptual issues are not so numerous, we do believe that they are
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19 persuasive enough. This does by any means intend to devalue the theoretical reasoning *per se*,
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21 rather, rooting theory on an empirical ground. In other respects, despite its limitations, the analysis
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23 of introductory textbooks seems to capture an intuitive “picture” of the “core” of a science, and the
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25 constructs we have analyzed could be easily seen as “pillars” of psychology by many researchers.
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27 Furthermore, it would be impossible to conduct an analysis on an uncontroversial list of constructs,
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29 because, according to our knowledge, such a list simply does not exist. Finally, the motives we have
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31 brought into discussion to “elect” evolutionary psychology as the most compelling metatheory are
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33 reasonable, nor totaling or orthodox.
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40 The theoretical chaos affecting psychology is not news (James, 1894; Heidbreder, 1933;
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42 Cronbach, 1957; Miller, 1985), however, most unification claims have been made in an
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44 argumentative fashion and have focused on methodological, philosophical and conceptual issues.
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46 On the other hand, many studies have been conducted to prove that psychology is more chaotic and
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48 “softer” than other sciences, or to assess the prominence of its “school of thoughts”. None of these
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50 studies, however, have directly made a claim in the unification issue. This article wants to be a
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52 bridge between these two respectful “traditions” to make a theoretical claim on an empirical
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54 ground.
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59 Overcoming a pre-paradigmatic condition with the aid of evolutionary psychology is in
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1 our opinion, a reachable and desirable aim. An evolutionary psychological approach must not be
2
3 intended as a monolithic theory but as a comprehensive and conciliatory approach, not excluding
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5 empirical findings of other theories. This would not mean an indiscriminate gathering of all the
6
7 theories, rather a coherent yet comprehensive application of the evolutionary principles in
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9 psychology. Finally, we believe that theoretical coherence and consistency can be pursued without
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11 orthodox tendencies.
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Appendix A - TABLES

TABLE A1. Definitions of psychology, mind & behavior

Authors	Psychology is the scientific study of	Mind is	Behavior is / refers to
Bernstein et Penner, Clarke-Stewart & Roy 2012 <i>Psychology, 9th edition</i>	Mind and behavior p.4.	X	X
Cacioppo & Freberg., 2013 <i>Discovering psychology: The science of mind</i>	Mind and behavior p.5	The brain and its activities, including thought, emotion, and behaviour. p.5	any action that we can observe p.5
Ciccarelli & White, 2018 <i>Psychology</i>	Mind and behavior p.44	all the internal, covert (hidden) activity such as thinking, feeling, and remembering p.44	all of our outward or overt actions and reactions, such as talking, facial expressions, and movement p.44
Feist & Rosenberg, 2012 <i>Psychology: Perspectives and Connections.</i>	thought and behavior p.5	Brain and behaviour p.5	X
Grison, Heatherton & Gazzaniga, 2017 <i>Psychology in your life</i>	Mind and behavior p.5	X	all of our actions that result from sensing and interpreting information p.5
Hockenbury, Nolan & Hockenbury, 2015 <i>Psychology (7th ed.)</i>	Mind and behavior and brain processes p.2	X	X
Lilienfeld, Lynn, Namy & Woolf, 2014 <i>Psychology: From inquiry to</i>	mind, brain, and behavior p.35	X	X

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1	<i>understanding</i> (3rd			
2	ed.)			
3				
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5	Myers & DeWall,	Mental processes	internal, subjective	anything an organism
6	2015	and behavior	experiences we	does—any action we can
7	<i>Psychology</i> (11th ed.)	<i>p.5</i>	infer from	observe and record
8			behavior—	<i>p.5</i>
9			sensations,	
10			perceptions,	
11			dreams, thoughts,	
12			beliefs, and	
13			feelings.	
14			<i>p.5</i>	
15			the private inner	observable actions of
16	Schacter, Gilbert,	mind and behavior	experience of	human beings and
17	Wegner & Nock,	<i>p.2</i>	perceptions,	nonhuman animals
18	2014		thoughts,	<i>p.2</i>
19	<i>Psychology</i> (3rd ed.)		memories, and	
20			feelings	
21			<i>p.2</i>	
22				
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27	VandenBos, 2015	the mind and	broadly, all	an organism’s activities in
28		behavior	intellectual and	response to external or
29		<i>p. 860</i>	psychological	internal stimuli
30	<i>APA dictionary of</i>		phenomena of an	<i>p.112</i>
31	<i>psychology, second</i>		organism,	
32	<i>edition</i>		encompassing	
33			motivational,	
34			affective,	
35			behavioral,	
36			perceptual, and	
37			cognitive systems;	
38			that is, the	
39			organized totality of	
40			an organism’s	
41			mental and psychic	
42			processes and the	
43			structural and	
44			functional cognitive	
45			components on	
46			which they depend.	
47			(...)	
48			<i>p.654</i>	
49			X	X
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54	Weiten, 2013	behavior and the		
55		physiological and		
56		cognitive processes		
57	<i>Psychology: Themes</i>	that underlie it		
58	<i>and variations, 9th</i>	<i>p.2</i>		
59	<i>edition</i>			
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1
2 Zimbardo, Johnson & behavior and mental *X* *X*
3 McCann, 2017 processes.
4 *p.2*
5
6 *Psychology: Core*
7 *concepts* (8th ed.)
8
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Note:

- 11 1. sign *X* when the definition has been found missing
- 12 2. in some tables, definitions have logic inconsistency. These inconsistencies (i.e. tautologies
- 13 or equivalences) are explained and highlighted in grey
- 14 3. when the original formulators have been explicitly cited by the authors, they have been
- 15 mentioned in the box and in the references
- 16 4. specific comments have been made in italics (e.g. subdivision of memory in long term
- 17 memory and short-term memory, etc.)
- 18 5. the pages on which the definitions are presented are listed below the definitions.
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TABLE A2. Definitions of attention, consciousness & cognition

Authors	(selective) Attention	Consciousness	Cognition
Bernstein et al., 2012 <i>Psychology, 9th edition</i>	The process of directing and focusing psychological resources to enhance perception, performance, and mental experience <i>p.184</i>	Tautological: Awareness of external stimuli and one's own mental activity. (Metzinger, 2000; Zeman, 2001) <i>p.331</i>	X
Cacioppo & Freberg, 2013 <i>Discovering psychology: The science of mind</i>	X	Tautological: A state of awareness . <i>p.236</i>	Internal mental processes including information processing, thinking, reasoning, and problem solving. <i>p.454</i>
Ciccarelli & White, 2018 <i>Psychology</i>	X	Tautological: a person's awareness of everything that is going on around him or her at any given time.(Farthing, 1992) <i>p.178</i>	Considered as equal to thinking mental activity that goes on in the brain when a person is organizing and attempting to understand information and communicating information to others. <i>p.306</i>
Feist & Rosenberg, 2012 <i>Psychology: Perspectives and Connections.</i>	the limited capacity to process information that is under conscious control. (Styles, 2006) <i>p.230</i>	Tautological: an awareness of one's surroundings and of what's in one's mind at a given moment; includes aspects of being awake and aware. <i>p.226</i>	mental processes involved in acquiring, processing, and storing knowledge. <i>p.364</i>
Grison et al., 2017 <i>Psychology in your life</i>	X	Tautological: The combination of a person's subjective experience of the external world and the person's mental activity; this	X

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			combination results from brain activity. <i>p.79</i>	
Hockenbury et al., 2015 <i>Psychology (7th ed.)</i>	the capacity to selectively focus senses and awareness on particular stimuli or aspects of the environment (Chun, Golomb & Turk Brown, 2011; Posner & Rothbart, 2007) <i>p.135</i>	Tautological: Personal awareness of mental activities, internal sensations, and the external environment <i>p.135</i>	mental activities involved in acquiring, retaining, and using knowledge <i>p.273</i>	
Lilienfeld et al., 2014 <i>Psychology: From inquiry to understanding (3rd ed.)</i>	X	Tautological: our subjective experience of the world, our bodies, and our mental perspectives <i>p. 200</i>	Considered as equal to thinking the term psychologists use to describe the mental processes involved in different aspects of thinking <i>p.61</i>	
Myers & DeWall, 2015 <i>Psychology (11th ed.)</i>	the focusing of conscious awareness on a particular stimulus. <i>p.96</i>	X	all the mental activities associated with thinking, knowing, remembering, and communicating. <i>p.357</i>	
Schacter et al., 2014 <i>Psychology (3rd ed.)</i>	perceiving only what's currently relevant to you <i>p.135</i>	Tautological: A person's subjective experience of the world and the mind. <i>p.178</i>	X	
VandenBos, 2015 <i>APA dictionary of psychology, second edition</i>	a state in which cognitive resources are fo cused on certain aspects of the environment rather than on others and the central nervous system is in a state of readiness to respond to stimuli. <i>p.87</i>	Tautological: 1. the state of being conscious . 2. an organism's awareness of something either internal or external to itself. <i>p.236</i>	all forms of knowing and awareness, such as perceiving, conceiving, remembering, reasoning, judging, imagining, and problem solving. <i>p.201</i>	
Weiten, 2013	focusing awareness on	Tautological: is the	refers to the mental	

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<i>Psychology: Themes and variations, 9th edition</i>	a narrowed range of stimuli or events. <i>p.275</i>	awareness of internal and external stimuli. <i>p.184</i>	processes involved in acquiring knowledge <i>p.14</i> // refers broadly to mental processes or thinking <i>p.314</i>
Zimbardo et al., 2017 <i>Psychology: Core concepts (8th ed.)</i>	a feature that makes one item stand out among others in consciousness <i>p.290</i>	The brain process that creates our mental representation of the world and our current thoughts. <i>p.289</i>	information processing in the brain <i>p.190</i>

Note:

1. sign **X** when the definition has been found missing
2. in some tables, definitions have logic inconsistency. These inconsistencies (i.e. tautologies or equivalences) are explained and highlighted in grey
3. when the original formulators have been explicitly cited by the authors, they have been mentioned in the box and in the references
4. specific comments have been made in italics (e.g. subdivision of memory in long term memory and short-term memory, etc.)
5. the pages on which the definitions are presented are listed below the definitions.

Attention is as multifaceted construct rather than a single concept. Many components have been proposed: selective attention (subdivided in feature-based, object-based, space-based), sustained attention, executive attention... In order not to broaden uncontrollably, our analysis focused on the concept of selective attention alone.

TABLE A3. Definitions of decision-making, intelligence & language

Authors	Decision-making	Intelligence	Language
Bernstein et al., 2012 <i>Psychology, 9th edition</i>	X	cognitive ability: the capacity to reason, remember, understand, solve problems, and make decisions <i>p.373</i> // Personal attributes that center around skill at information processing, problem solving, and adapting to new or changing environments <i>p.374</i>	Symbols and a set of rules for combining them that provide a vehicle for communication. p.315
Cacioppo & Freberg, 2013 <i>Discovering psychology: The science of mind</i>	X	The ability to understand complex ideas, adapt effectively to the environment, learn from experience, engage in reasoning, and overcome obstacles. (Neisser et al., 1996, p. 77) <i>p.489</i>	A system for communicating thoughts and feelings using arbitrary signals. <i>p.478</i>
Ciccarelli & White, 2018 <i>Psychology</i>	process of cognition that involves identifying, evaluating, and choosing among several alternatives. <i>p.311</i>	The ability to learn from one's experiences, acquire knowledge, and use resources effectively in adapting to new situations or solving problems (Sternberg & Kaufman, 1998; Wechsler, 1975) <i>p.311</i>	a system for combining symbols (such as words) so that an unlimited number of meaningful statements can be made for the purpose of communicating with others. <i>p.338</i>
Feist & Rosenberg, 2012	X	a set of cognitive skills that includes	a communication system specific to

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Psychology: Perspectives and Connections.

abstract thinking, reasoning, problem solving, and the ability to acquire knowledge.

p.387

Homo sapiens; it is open and symbolic, has rules of grammar, and allows its users to express abstract and distant ideas.

(Bickerton, 1995)

Grison et al., 2017

Psychology in your life

attempting to select the best alternative among several options.

p.278

The ability to use knowledge to reason, make decisions, make sense of events, solve problems, understand complex ideas, learn quickly, and adapt to environmental challenges

p.287

p.349

X

Hockenbury et al., 2015

Psychology (7th ed.)

X

the global capacity to think rationally, act purposefully, and deal effectively with the environment

(Wechsler, 1944, 1977)

p.290

A system for combining arbitrary symbols to produce an infinite number of meaningful statements.

p.284

Lilienfeld et al., 2014

Psychology: From inquiry to understanding (3rd ed.)

the process of selecting among a set of possible alternatives

p. 325

X

largely arbitrary system of communication that combines symbols (such as words and gestural signs) in rule-based ways to create meaning

p.330

Myers & DeWall, 2015

Psychology (11th ed.)

X

the mental potential to learn from experience, solve problems, and use knowledge to adapt to new situations.

p.386

our spoken, written, or signed words and the ways we combine them to communicate meaning.

p.370

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1	Schacter et al., 2014	X		the ability to direct	a system for
2				one's thinking, adapt	communicating with
3				to one's	others using signals
4	<i>Psychology</i> (3rd ed.)			circumstances, and	that are combined
5				learn from one's	according to rules of
6				experiences	grammar and convey
7				(Gottfredson, 1997)	meaning.
8				<i>p.396</i>	<i>p.352</i>
9					
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13	VandenBos, 2015		the cognitive process	the ability to derive	system for expressing
14			of choosing between	information, learn	or communicating
15			two or more	from experience,	thoughts and feelings
16			alternatives, ranging	adapt to the	through speech sounds
17	<i>APA dictionary of</i>		from the relatively	environment,	or written symbols.
18	<i>psychology, second</i>		clear cut (e.g.,	understand, and	<i>p.585</i>
19	<i>edition</i>		ordering a meal at a	correctly utilize	
20			restaurant) to the	thought and reason.	
21			complex (e.g.,	<i>p.548</i>	
22			selecting a mate).		
23			<i>p.286</i>		
24					
25					
26					
27	Weiten, 2013		evaluating alternatives	X	consists of symbols
28			and making choices		that convey mean- ing,
29			among them.		plus rules for
30	<i>Psychology: Themes</i>		<i>p.333</i>		combining those
31	<i>and variations, 9th</i>				symbols, that can be
32	<i>edition</i>				used to generate an
33					infinite variety of
34					messages
35					<i>p.314</i>
36					
37					
38					
39	Zimbardo et al., 2017	X		is the mental capacity	our ability to
40				to acquire knowledge,	communicate through
41	<i>Psychology: Core</i>			reason, and solve	spoken and written
42	<i>concepts (8th ed.)</i>			problems effectively	words and gesture
43				<i>p.207</i>	<i>p.245</i>
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Note:

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3. when the original formulators have been explicitly cited by the authors, they have been mentioned in the box and in the references
4. specific comments have been made in italics (e.g. subdivision of memory in long term memory and short-term memory, etc.)
5. the pages on which the definitions are presented are listed below the definitions.

TABLE A4 Definitions of learning, memory & perception

Authors	Learning	Memory	Perception
Bernstein et al., 2012 <i>Psychology, 9th edition</i>	The modification through experience of preexisting behavior and understanding <i>p.197</i>	X	The process through which sensations are interpreted, using knowledge and understanding of the world, so that they become meaningful experiences. <i>p.157</i>
Cacioppo & Freberg, 2013 <i>Discovering psychology: The science of mind</i>	A relatively permanent change in behavior or the capacity for behavior due to experience. <i>p.350</i>	The ability to retain knowledge. <i>p.399</i>	The process of interpreting sensory information. <i>p.181</i>
Ciccarelli & White, 2018 <i>Psychology</i>	any relatively permanent change in behavior brought about by experience or practice. <i>p.218</i>	an active system that receives information from the senses, puts that information into a usable form, and organizes it as it stores it away, and then retrieves the information from storage. (adapted from Baddeley, 1996, 2003). <i>p.264</i>	the method by which the sensations experienced at any given moment are interpreted and organized in some meaningful fashion. <i>p.160</i>
Feist & Rosenberg, 2012 <i>Psychology: Perspectives and Connections.</i>	enduring changes in behavior that occur with experience. <i>p.306</i>	the ability to store and use information. <i>p.270</i>	the act of organizing and interpreting sensory experience <i>p.125</i>
Grison et al., 2017 <i>Psychology in your life</i>	a change in behavior, resulting from experience. <i>p.197</i>	The nervous system's capacity to acquire and retain skills and knowledge for later	The processing, organization, and interpretation of sensory signals in the brain; these processes

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			retrieval. <i>p.233</i>	result in an internal neural representation of the physical stimulus. <i>p.157</i>
Hockenbury et al., 2015 <i>Psychology (7th ed.)</i>	A process that produces a relatively enduring change in behavior or knowledge as a result of past experience. <i>p.183</i>	refers to the mental processes that enable us to acquire, retain, and retrieve information. <i>p.228</i>	The process of integrating, organizing, and interpreting sensations. <i>p.86</i>	
Lilienfeld et al., 2014 <i>Psychology: From inquiry to understanding (3rd ed.)</i>	change in an organism's behavior or thought as a result of experience <i>p. 236</i>	retention of information over time <i>p.276</i>	The brain's interpretation of raw sensory inputs <i>p.156</i>	
Myers & DeWall, 2015 <i>Psychology (11th ed.)</i>	the process of acquiring through experience new information or behaviors. <i>p.280</i>	The persistence of learning over time through the encoding, storage, and retrieval of information. <i>p.318</i>	the process of organizing and interpreting sensory information, enabling us to recognize meaningful objects and events. <i>p.230</i>	
Schacter et al., 2014 <i>Psychology (3rd ed.)</i>	involves the acquisition of new knowledge, skills, or responses from experience that results in a relatively permanent change in the state of the learner <i>p.266</i>	The ability to store and retrieve information over time. <i>p.222</i>	The organization, identification and interpretation of a sensation in order to form a mental representation. <i>p.130</i>	
VandenBos, 2015 <i>APA dictionary of psychology, second edition</i>	the acquisition of novel information, behaviors, or abilities after practice, observation, or other experiences, as evidenced by change in behavior, knowledge, or brain function	the ability to retain information or a representation of past experience, based on the mental processes of learning or encoding, retention across some interval of time, and retrieval or reactivation of the memory.	the process or result of becoming aware of objects, relationships, and events by means of the senses, which includes such activities as recognizing, observing, and discriminating. These activities enable organisms to organize	

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1		<i>p. 594</i>	<i>p.636</i>	and interpret the
2				stimuli received into
3				meaningful knowledge
4				and to act in a
5				coordinated manner.
6				<i>p.775</i>
7				is the selection,
8	Weiten, 2013	is any relatively	X	organization, and
9		durable change in		interpretation of
10	<i>Psychology: Themes</i>	behavior or		sensory input
11	<i>and variations, 9th</i>	knowledge that is due		<i>p. 130</i>
12	<i>edition</i>	to experience		
13		<i>p.230</i>		
14				
15				
16	Zimbardo et al.,	a process through	Human memory is an	mental process that
17	2017	which experience	information	elaborates and assigns
18		produces a lasting	processing system that	meaning to the
19		change in behavior or	works constructively	incoming sensory
20	<i>Psychology: Core</i>	mental processes	to encode, store, and	patterns
21	<i>concepts (8th ed.)</i>	<i>p.118</i>	retrieve information.	<i>p.76</i>
22			<i>p.154</i>	
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Note:

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5. the pages on which the definitions are presented are listed below the definitions.

Like attention, memory is a multifaceted phenomenon rather than a single concept. Sensorial memory, working memory, short-term memory, long term memory (divided in episodic, semantic, explicit or implicit memory), are all dimensions currently studied. In order not to broaden excessively our analysis our focus has been on the general definition of the term.

TABLE A5. Definitions of problem-solving, reasoning & sensation

Authors	Problem-solving	Reasoning	Thinking
Bernstein et al., 2012 <i>Psychology, 9th edition</i>	X	The process by which people generate and evaluate arguments and reach conclusions about them p.295	The manipulation of mental representations p.287
Cacioppo & Freberg, 2013 <i>Discovering psychology: The science of mind</i>	The use of information to meet a specific goal. (Lovett, 2002) p.462	X	X
Ciccarelli & White, 2018 <i>Psychology</i>	process of cognition that occurs when a goal must be reached by thinking and behaving in certain ways. p.311	X	considered as equal to cognition mental activity that goes on in the brain when a person is organizing and attempting to understand information and communicating information to others. p.306
Feist & Rosenberg, 2012 <i>Psychology: Perspectives and Connections.</i>	X	the process of drawing inferences or conclusions from principles and evidence. (Sternberg, 2006) p.368	X
Grison et al., 2017 <i>Psychology in your life</i>	Finding a way around an obstacle to reach a goal. p.278	Using information to determine if a conclusion is valid or reasonable. p. 277	The mental manipulation of representations of information we encounter in our environments p.271
Hockenbury et al.,	Thinking and behavior	X	The manipulation of

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1	2015	directed toward		mental representations
2		attaining a goal that is		of information in order
3	<i>Psychology (7th ed.)</i>	not readily available.		to draw inferences and
4				conclusions.
5		(Novick & Bassok,		
6		2005)		<i>p.273</i>
7				
8		<i>p.277</i>		
9				
10				
11	Lilienfeld et al.,	generating a cognitive	X	any mental activity or
12	2014	strategy to accomplish		processing of
13		a goal		information, including
14	<i>Psychology: From</i>	<i>p. 326</i>		learning, remembering,
15	<i>inquiry to</i>			perceiving,
16	<i>understanding (3rd</i>			communicating,
17	<i>ed.)</i>			believing, and deciding
18				<i>p. 320</i>
19				
20				
21				
22				
23				
24	Myers & DeWall,	X	X	X
25	2015			
26				
27	<i>Psychology (11th</i>			
28	<i>ed.)</i>			
29				
30	Schacter et al., 2014	X		X
31			mental activity that	
32	<i>Psychology (3rd ed.)</i>		consists of organizing	
33			information or beliefs	
34			into a series of steps	
35			in order to reach	
36			conclusions.	
37			<i>p.388</i>	
38				
39				
40				
41	VandenBos, 2015	the process by which	thinking in which	cognitive behavior in
42		individuals attempt to	logical processes of an	which ideas, images,
43		overcome difficulties,	inductive or deductive	mental representations,
44	<i>APA dictionary of</i>	achieve plans that	character are used to	or other hypothetical
45	<i>psychology, second</i>	move them from a	draw conclusions	elements of thought are
46	<i>edition</i>	starting situation to a	from facts or	experienced or
47		desired goal, or reach	premises.	manipulated.
48		conclusions through	<i>p.886</i>	<i>p.1084</i>
49		the use of higher		
50		mental functions, such		
51		as reasoning and		
52		creative thinking		
53		<i>p.837, 838</i>		
54				
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56				
57				
58	Weiten, 2013		X	X
59		active efforts to		
60	<i>Psychology: Themes</i>	discover what must be		
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1	<i>and variations, 9th</i>	done to achieve a goal		
2	<i>edition</i>	that is not readily		
3		attainable.		
4				
5		<i>p.324</i>		
6				
7	Zimbardo et al.,	X	the ability to compare	Thinking is a cognitive
8	2017		and evaluate	process in which the
9			contradictory view-	brain uses information
10			points (Baltes &	from the senses,
11			Staudinger, 1993;	emotions, and memory
12	<i>Psychology: Core</i>		King & Kitchener,	to create and
13	<i>concepts (8th ed.)</i>		1994)	manipulate mental
14			<i>p.275</i>	representations, such as
15				concepts, images,
16				schemas, and scripts.
17				<i>p.190</i>
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TABLE A5 Definitions of thinking, emotion & motivation

Authors	Emotion	Motivation	Sensation
Bernstein et al., 2012 <i>Psychology, 9th edition</i>	Transitory positive or negative experiences that are felt as happening to the self, are generated in part by cognitive appraisal of a situation, and are accompanied by both learned and innate physical responses. <i>p.446</i>	The factors that influence the initiation, direction, intensity, and persistence of behavior (Reeve, 1996) <i>p.413</i>	Messages from the senses that make up the raw information that affects many kinds of behavior and mental processes <i>p.109</i>
Cacioppo & Freberg, 2013 <i>Discovering psychology: The science of mind</i>	A combination of arousal, physical sensations, and subjective feelings that occurs spontaneously in response to environmental stimuli. <i>p.288</i>	A process that arouses, maintains, and guides behavior toward a goal. <i>p.289</i>	The process of detecting environmental stimuli or stimuli arising from the body. <i>p.181</i>
Ciccarelli & White, 2018 <i>Psychology</i>	the “feeling” aspect of consciousness, characterized by a certain physical arousal, a certain behavior that reveals the emotion to the outside world, and an inner awareness of feelings. <i>p.413</i>	the process by which activities are started, directed, and continued so that physical or psychological needs or wants are met. (Petri, 1996) <i>p.396</i>	the process that occurs when special receptors in the sense organs are activated, allowing various forms of outside stimuli to become neural signals in the brain. <i>p.134</i>
Feist & Rosenberg, 2012 <i>Psychology: Perspectives and Connections.</i>	brief, acute changes in conscious experience and physiology that occur in response to a personally meaningful situation. <i>p.449</i>	the urge to move toward one’s goals <i>p.426</i>	The stimulation of our sense organs by the outer world <i>p.124</i>
Grison et al., 2017 <i>Psychology in your</i>	Feelings that involve	Factors of differing	The sense organs’ detection of external physical stimulus and

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1	<i>life</i>	physical responses, changes in thoughts and in actions, and personal evaluation. <i>p.324</i>	strength that energize, direct, and sustain behavior. <i>p.309</i>	the transmission of information about this stimulus to the brain. <i>p.157</i>
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10	Hockenbury et al., 2015	A complex psychological state that involves a subjective experience, a physiological response, and a behavioral or expressive response. <i>p.330</i>	The biological, emotional, cognitive, or social forces that activate and direct behavior. <i>p.314</i>	The process of detecting a physical stimulus, such as light, sound, heat, or pressure. <i>p.86</i>
11				
12	<i>Psychology (7th ed.)</i>			
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22	Lilienfeld et al., 2014	mental state or feeling associated with our evaluation of our experiences <i>p.442</i>	psychological drives that propel us in a specific direction <i>p.465</i>	detection of physical energy by sense organs, which then send information to the brain <i>p.156</i>
23				
24	<i>Psychology: From inquiry to understanding (3rd ed.)</i>			
25				
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31	Myers & DeWall, 2015	a response of the whole organism, involving (1) physiological arousal, (2) expressive behaviors, and (3) conscious experience. <i>p.461</i>	a need or desire that energizes and directs behavior. <i>p.420</i>	the process by which our sensory receptors and nervous system receive and represent stimulus energies from our environment. <i>p.230</i>
32				
33	<i>Psychology (11th ed.)</i>			
34				
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41	Schacter et al., 2014	positive or negative experience that is associated with a particular pattern of physiological activity. <i>p.316</i>	the purpose for or psychological cause of an action <i>p.330</i>	simple stimulation of a sense organ <i>p.130</i>
42				
43	<i>Psychology (3rd ed.)</i>			
44				
45				
46				
47				
48				
49			<i>disposition, impetus, cause - purpose</i>	
50				
51				
52	VandenBos, 2015	complex reaction pattern, involving experiential, behavioral, and physiological elements, by which an individual attempts to deal with a personally	the impetus that gives purpose or direction to behavior and operates in humans at a conscious or unconscious level	the process or experience of perceiving through the senses. <i>p.962</i>
53				
54	<i>APA dictionary of psychology, second edition</i>			
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significant matter or event. *p.670*

p.362

Weiten, 2013

Psychology: Themes and variations, 9th edition

involves (1) a subjective conscious experience (the cognitive component) accompanied by (2) bodily arousal (the physiological component) and by (3) characteristic overt expressions (the behavioral component

p. 411

Zimbardo et al., 2017

Psychology: Core concepts (8th ed.)

Emotion is a process involving four main components: physiological arousal, cognitive interpretation, subjective feelings, and behavioral expression (...) Emotions are a special class of motives that help us attend to and respond to important (usually external) situations and communicate our intentions to others

p.361

involves goal-directed behavior.

p.388

Motives are internal dispositions to act in certain ways, although they can be influenced by multiple factors, both internal and external.

p.324

the stimulation of sense organs *p. 130*

process by which a stimulated receptor (such as the eyes or ears) creates a pattern of neural messages that represent the stimulus in the brain, giving rise to our initial experience of the stimulus.

p.765

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Compliance with Ethical Standards

Conflict of Interest: Andrea Zagaria declares that he has no conflict of interest. Agata Andò declares that she has no conflict of interest. Alessandro Zennaro declares that he has no conflict of interest.

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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