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RESEARCH ARTICLE

Soft Core Evolutionary Psychology? Potential Evidence Against a Unified Research Program from a Survey of 581 Evolutionarily Informed Scholars

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Abstract

A recent philosophical examination of evolutionary psychology argues that it currently lacks a metatheoretical "hard core" and thus cannot be considered a mature science. It has been proposed instead that evolutionary psychology should be categorized as a pre-normal, but not pre-paradigm (as defined by Kuhn), science, given, on the one hand, substantial theoretical tensions but, on the other, evidence of impressive scientific progress. Yet a survey of controversial beliefs involving 581 evolutionarily informed scholars, the majority with psychology backgrounds, has found that they have "shared core beliefs" about a number of topics central to their field, which potentially suggests that there is a metatheory or "hard core" uniting evolutionary psychology. The current study reconsidered these data using factor analysis in an effort to identify the presence of a latent Core Beliefs factor, which if present could be reasonably interpreted as reflecting a widely accepted (implicitly or explicitly) metatheory. A single-factor solution did not fit these data, however. Instead, three belief-cluster factors emerged, corresponding to *Behavioral Genetics*, *Mainstream Evolutionary Psychology* (characterized by certain beliefs about massive modularity, menstrual cycles, sex differences, life history, and developmental influences), and *Biocultural Dynamics* (characterized by certain beliefs about population differences and group selection). Mostly weak but positive inter-factor correlations were noted, which suggest the potential future development of a unitary metatheory. Participant training background was examined as a predictor of endorsement of the different belief-cluster factors, and significant evidence of influence was observed in some cases. While these data could be taken as evidence that evolutionary psychology is not yet a fully "normal" science, having only a metatheoretical "soft core," this view faces certain challenges.

Keywords Evolutionary psychology · Exploratory factor analysis · Metatheory · Research program

Introduction

Do evolutionary psychologists share a common research program? Or does evolutionary psychology merely contain competing programs without a unitary metatheoretical core? Using concepts drawn from both Kuhnian and Lakatosian philosophy of science, Egeland (2023) has argued that evolutionary psychology lacks a very generally accepted metatheory. An implication of this is that it cannot (yet) be considered a fully mature science.

Kuhn (1962) employed the term *paradigm* to refer to something at least close to a scientific research program. His understanding of the meaning of "paradigm" is controversial because he appears to have used the word in more than one way. Nonetheless, it seems that in its most elaborate sense, Kuhn took a paradigm to involve consensus not only on fundamental theoretical matters, but also on what constitutes appropriate methodology and the correct use of theory to integrate new data into scientific explanations. Practitioners of science operating within a given paradigm can be said to be practicing *normal science*, which is basically the solving of small problems that Kuhn called puzzles. Prior to

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this (the *pre-paradigm* stage), scientific practice is disorganized, characterized by debates over fundamental scientific questions and a multiplicity of competing theories, each of which lacks maturity and authoritative standing. With the emergence of a paradigm, a science enters the mature stage. Part of a mature science is that paradigms are upset by crises, which arise when researchers come to believe that a paradigm cannot successfully explain problems or anomalies, that those researchers have come to recognize as serious—normal science proves unable to resolve these anomalies. Crises can engender radical theoretical developments that bring about a new paradigm, to replace the failed one, in which normal science again can be conducted—this process of transition being a scientific revolution.

Lakatos (1970) offered a potentially more richly developed view of the scientific process than Kuhn. One way he differed from Kuhn is that he argued that the typical situation in a scientific field involves rival research programs, not merely one central program that commands very wide assent. Any particular research program generates theories—associated with certain hypotheses—that are united through a common set of fundamental assumptions, which Lakatos called "hard core" assumptions, but that also have been collectively termed the metatheory or metatheoretical assumptions of a research program. Within the research program, this metatheory is treated as "'irrefutable' by the methodological decision of its proponents" (Lakatos, 1970, p. 48; Lakatos clarifies, however, that metatheories develop slowly—they are not simply decided on "all at once," so to speak). This effective "irrefutability" Lakatos called the "negative heuristic" of the hard core (Lakatos, 1970, p. 50). In practice, the negative heuristic guides science in such a way that an anomaly for any particular theory in a research program is understood as indicating a need for revision of that theory or an associated hypothesis (or hypotheses), but *not*, or even never, the metatheory that unites all of the research program's theories. Specifically, Lakatos envisioned a research program's metatheory as protected by a "belt" of "auxiliary hypotheses" that are changed or replaced to contend with anomalous data and theory failure, such that the hard core need not be changed or replaced when a hypothesis fails to find support or a theory makes many incorrect predictions. The "positive heuristic" of the hard core is summarized as "a partially articulated set of suggestions or hints on how to change, develop the 'refutable variants' of the research program, how to modify, sophisticate, the 'refutable' protective belt" (Lakatos, 1970, p. 50).

In an analysis of the maturity of evolutionary psychology as a scientific field, Egeland (2023) observes that proponents of evolutionary psychology, such as Ketelaar and Ellis (2000), have argued that it has a unified research program. He highlights specifically the latter authors' claim that evolutionary psychology's metatheory comprises "the general principles of genetical evolution drawn from modern evolutionary theory" (Ketelaar & Ellis, 2000, p. 393). Egeland (2023) explains Ketelaar and Ellis' Lakatosian accounting of evolutionary psychology as follows:

> The protective belt, Ketelaar and Ellis ... tell us, is broken down into three levels of analysis: middle-level theories, hypotheses, and predictions. Middle-level theories ... are consistent with the hard core, and they provide inferential links to specific hypotheses from which testable predictions can be derived. (pp. 393-394)

Examples of middle-level theories in evolutionary psychology include life history and sexual selection.

Egeland (2023) argues, however, that this proposed metatheory is excessively broad, since everything in it is already contained in the metatheory of evolutionary *biology*. If evolutionary psychology is supposed to be a distinct field, it should be consistent with and grounded in evolutionary biology, but meaningfully independent from the latter. He contends that understanding evolutionary psychology's research program as having such a general metatheory would entail that even the anti-adaptationist "program" of Stephen Jay Gould and Richard Lewontin (1979) could be part of evolutionary psychology, when, in reality, evolutionary psychologists are adaptationists, more or less universally (see Andrews et al. (2002), and commentaries therein; see Krasnow and Truxaw (2018) for discussion of the meaning of adaptationism in evolutionary psychology and biology).

Egeland (2023) also maintains that among (in some cases, self- or other-identified) practitioners of evolutionary psychology, there are substantial and foundational theoretical disagreements concerning a number of issues. The major debates include the reality and nature of context-sensitive modules; the role of epigenetics and individual differences (especially heritable ones) in adaptationist theorizing; the significance of human universals; and the existence of ongoing human genetic evolution, group and multi-level selection, and domain-general adaptations. In discussing these controversies, some researchers have qualitatively decomposed the field into two primary "clusters." Researchers operating within the theoretical rubric of the Santa Barbara School (SBS), explained by Tooby and Cosmides (2005), constitute one major research cluster, while the remainder, who operate (to various degrees) outside of the SBS, constitutes a second and much looser research cluster (an example of one such competing approach would be the *culture-gene co-evolution model*: Frost, 2011; Lloyd and Feldman, 2002). The SBS has (perhaps controversially) been termed the "High Church" by some writers commenting on this apparent division (Heyes (2012); the remainder has been termed the "Broad Church" by Woodley of Menie and Sarraf (2018)). These two clusters have also been demarcated as Evolutionary Psychology and evolutionary psychology, respectively (e.g., Buller, 2005;

Dowens, 2021; Heyes, 2012). Egeland (2023) argues that, were evolutionary psychology a mature science with a unifying hard core, such fundamental internal tensions would have been relegated to scientific history. Moreover, were it the case that evolutionary psychology was properly metatheoretically integrated with respect to wider evolutionary theory to the degree claimed by Ketelaar and Ellis (2000), the intensity of controversy stemming from the broader field of evolutionary biology (some of which, it should be noted, is motivated by extra-scientific concerns—see discussion in Burke (2021) and Woodley of Menie and Sarraf (2018)) might be expected to be lower (see Lloyd and Feldman (2002) for discussion of the theoretical tensions between evolutionary psychology and evolutionary biology more broadly).

On this basis, Egeland (2023) argues that the field of evolutionary psychology may represent (what could be termed) *pre-normal* science but not pre-paradigm science in the Kuhnian sense. As Egeland (2023) notes, "my argument that evolutionary psychology has not reached the stage of normal science should not be interpreted as implying that it has the properties associated with Kuhn's previous stage (the pre-paradigm stage), which would imply that there is almost no agreement at all in the discipline and that there is virtually no progress being made" (p. 406). This intermediary stage could be said to exist between Kuhnian "pre-paradigm" and "normal" science and allows for the existence of fields that simultaneously appear to lack a well-defined metatheoretical core, yet that also are clearly making scientific progress, which in turn suggests movement toward the stage of normal science: "although there is not at the moment any unifying research program in evolutionary psychology, one nevertheless finds fruitful and progressive theoretical developments being made, and it is certainly possible that the discipline will enter the stage of normal science in the near future" (Egeland, 2023, p. 406).

In making this case, Egeland (2023) relies primarily on philosophical arguments. But of course, empirical claims concerning the status of various perspectives in the field must be evaluated on their own terms (a point that Egeland emphasizes: see footnote 8, p. 393). Therefore, an attempt to shed some light on the question of evolutionary psychology's status as a science with relevant data is deemed worthwhile.

A recent survey (Kruger et al., 2021) of the diversity of opinion in a sample of 581 "evolutionarily-informed scholars," primarily with psychology backgrounds, on "key and contested aspects of human behavior" (p. 11; i.e., the main subject matter of evolutionary psychology) found that "nearly all participants believed that developmental environments substantially shape human adult psychology and behavior, that there are differences in human psychology and behavior based on sex differences from sexual selection, and that there are individual differences in human psychology and behavior resulting from different genotypes" (p. 11). Kruger et al. (2023) maintain that this suggests the existence of "shared core beliefs" co-existing along with "phenomena that are accepted by varying proportions of scholars" (p. 11). Kruger et al. (2023) based their argument on the comparison of proportions of affirmative responses (endorsements) to various questions concerning the significance of certain theoretical perspectives and on the use of a correlation matrix. At first glance, this finding could be taken to challenge Egeland's (2023) basic argument, as perhaps these three apparently widely shared theoretical positions reflect the influence of a hard core in evolutionary psychology, or at least among evolutionarily informed scholars with meaningful knowledge of human psychology and behavior (which would include psychologists but also other kinds of researchers such as anthropologists). Indeed, where this is the case, certain patterns might be expected to emerge from the reanalysis of the raw data in Kruger et al. (2023). Factor analysis and related latent variable modeling techniques can be used to identify research paradigms or programs when certain kinds of data are considered (Figueredo et al., 2013a, b). It thus should be possible to establish the existence of an overarching latent *Core Beliefs* factor, superordinate to but explaining the general endorsement of these subordinate belief clusters that correspond roughly to sets of related mid-level theories. Establishing the existence of such a *Core Beliefs* factor then could then be empirical evidence of a hard core within this research community, which would challenge Egeland's (2023) arguments to the contrary.

Methods

Data

The data employed in Kruger et al. (2023) and in the current study were collected as part of the *Survey of Evolutionary Scholars* in 2020, and in such a way that would primarily if not overwhelmingly sample researchers in evolutionary psychology. Specifically, "*E*-mail invitations were sent to (1) participants in the first wave of the Survey of Evolutionary Scholars who agreed to participate in future research and provided an e-mail address; (2) The membership of the International Society for Human Ethology; (3) The membership of the Northeastern Evolutionary Psychology Society and other individuals listed in conference programs (2008–2019); (4) individuals listed in conference programs of the Human Behavior and Evolution Society (2014–2019)" (p. 14). Coverage with respect to sex, nationality, and degree of professional standing was broad. The majority of participants had psychology backgrounds (58%), with most of the remainder reporting backgrounds in either anthropology (18%) or biology (6%). A small minority reported

other academic backgrounds (< 2%) (~ 16% did not disclose a specific field).

Participants were asked a series of questions concerning their beliefs about the importance of 10 statements relating to controversial issues in evolutionary psychology. These included the importance of developmental environments to adult behavioral outcomes, the importance of massive modularity, the importance of group selection, the importance of sexual selection, the importance of genetically conditioned individual differences, the importance of population differences, and the importance of the menstrual cycle as a determinant of intra-individual behavioral differences in woman. For each question, respondents could answer "yes," "no," or "don't know." In order to generate their correlation matrix, Kruger et al. (2023) coded response patterns to their items as follows: endorsement (yes) = 1, non-endorsement (no and don't know) = 0.

Statistical Analyses

All analyses were conducted in *R* version 4.0.1 (R Core Team, 2020). Owing to the binary (1, 0) nature of the data, a non-parametric (Spearman) correlation matrix was generated with the *cor* function. Subsequently, Kaiser–Meyer–Olkin (KMO) and Bartlett tests were employed to determine whether the sample was adequate for exploratory factor analysis (EFA). The KMO and the Bartlett analyses were estimated with the *KMO* and *cortest.bartlett* functions found in the *psych* package (Revelle & Revelle, 2015). The current study used the *fa.parallel* function, also found in the *psych* package, to conduct Horn's parallel analysis and determine the number of factors to be retained. Based on the number of factors recommended by the parallel analysis, an EFA was conducted with maximum likelihood and based on squared multiple correlations. The model fit was examined using the Tucker-Lewis index (*TLI*) and root mean square error of approximation (*RMSEA*) values calculated with the *fa* function. The relevant factor scores were estimated with the *fa.scores* function.

Two contrasts were generated as predictors of belief-cluster endorsement patterns using a form of exploratory path analysis termed SEQuential canonical analysis (SEQCA; Figueredo & Gorsuch, 2007). The first contrast compared participants who did not have any psychological or anthropological training (*weight* = + 2) with participants who either had psychological training (*weight* = − 1) or anthropological training (*weight* = − 1). The second contrast excluded participants who did not have any psychological or anthropological training (*weight* = 0) and instead employed participants who had psychological training (*weight* = + 1) or anthropological training (*weight* = − 1). These conditions are listed in Table 1. The SEQCA was computed using *UniMult 2.0*. (Gorsuch, 2016).

Results

Sample Adequacy and Parallel Analysis

The results of the Kaiser–Meyer–Olkin factor adequacy test estimated an overall mean square error of approximation value of 0.69, with Bartlett's test reaching statistical significance ($x^2 = 439.06$, $p < 0.001$), indicating sample adequacy. Horn's parallel analysis recommended retaining three factors.

Exploratory Factor Analysis with Maximum Likelihood

Table 2 presents the results obtained with an EFA conducted using maximum likelihood. The analyses revealed that the first dimension (which is here termed the *Behavioral Genetics* factor) principally loaded positively and substantially onto the genetically conditioned individual differences item. This item (unsurprisingly) exhibited a large communality estimate ($h^2 = 0.995$). The second latent dimension (which is here termed the *Mainstream Evolutionary Psychology* factor) principally loaded positively onto items related to cognitive modularity, sex differences, menstrual cycles, life history, and developmental environments. Factor loadings ranged from 0.527 (cognitive modularity) to 0.302 (developmental environments). Sex differences exhibited the largest communality ($h^2 = 0.413$). The third latent dimension (termed the *Biocultural Dynamics* factor) principally loaded positively onto group selection and population differences, exhibiting factor loadings ranging from 0.574 to 0.250. Group selection exhibited the largest communality estimate ($h^2 = 0.327$).

The first latent dimension accounted for 15% of the total variance and 44% of the common variance. The second latent dimension explained 12% of the total variance and 37% of the common variance. The third latent dimension accounted for 7% of the total variance and 20% of the common variance. It should be noted that even though the model identified a sizable inter-factor correlation between the first and second factors, the very small magnitude correlations between the third latent dimension and the remaining two prevented the emergence of a *Core Beliefs* factor, favoring

Table 1 Contrast weights (for two different models) comparing participants who did not have any psychological training or anthropological training to participants who had either psychological or anthropological training

Categories	Contrast 1	Contrast 2
No psychological training and no anthropological training	Weight = + 2	Weight = 0
Psychological training	Weight = − 1	Weight = + 1
Anthropological training	Weight = − 1	Weight = − 1

Table 2 Results of an exploratory factor analysis with maximum likelihood and assuming a three-factor structure. Entries in bold correspond to the highest magnitude loadings exhibiting the greatest degree of factorial exclusivity. The model is based on a Spearman correlation matrix

Factor structure						
Indicator	***ML1***	***ML2***	***ML3***	h^2	u^2	***Com***
Individual genetic differences	**0.999**	−0.003	−0.003	0.995	0.005	1.000
Cognitive modularity	−0.053	**0.527**	−0.165	0.270	0.730	1.220
Sex differences	0.303	**0.448**	0.031	0.413	0.587	1.770
Menstrual cycle	0.063	**0.405**	0.041	0.194	0.806	1.070
Life history continuum	−0.104	**0.384**	0.171	0.162	0.838	1.550
Developmental environments	−0.004	**0.302**	0.267	0.175	0.825	1.970
Group selection	−0.017	−0.050	**0.574**	0.327	0.673	1.020
Population differences	0.128	0.223	**0.250**	0.167	0.833	2.490
Variance explained						
Statistic	***ML1***	***ML2***	***ML3***			
SS loadings	1.18	0.99	0.53			
Proportion of variance	0.15	0.12	0.07			
Cumulative variance	0.15	0.27	0.34			
Proportion explained	0.44	0.37	0.20			
Cumulative proportion	0.44	0.80	1.00			
Inter-factor correlation matrix						
Correlate	***ML1***	***ML2***	***ML3***			
ML1	1.00					
ML2	0.43	1.00				
ML3	0.08	0.08	1.00			

The model does not feature Heywood cases and exhibits good model fit: large *TLI*: 0.984 and small *RMSEA*: 0.0199

instead a three-factor solution with correlated factors. This is indicated by the model's fit indicators (TLI = 0.984; *RMSEA* = 0.0199), which support a three-factor structure. These analyses were also conducted using a tetrachoric correlation matrix, but the resultant model did not exhibit an adequate statistical fit (*TLI* = 0.289; *RMSEA* = 1.347) Fig. 1.

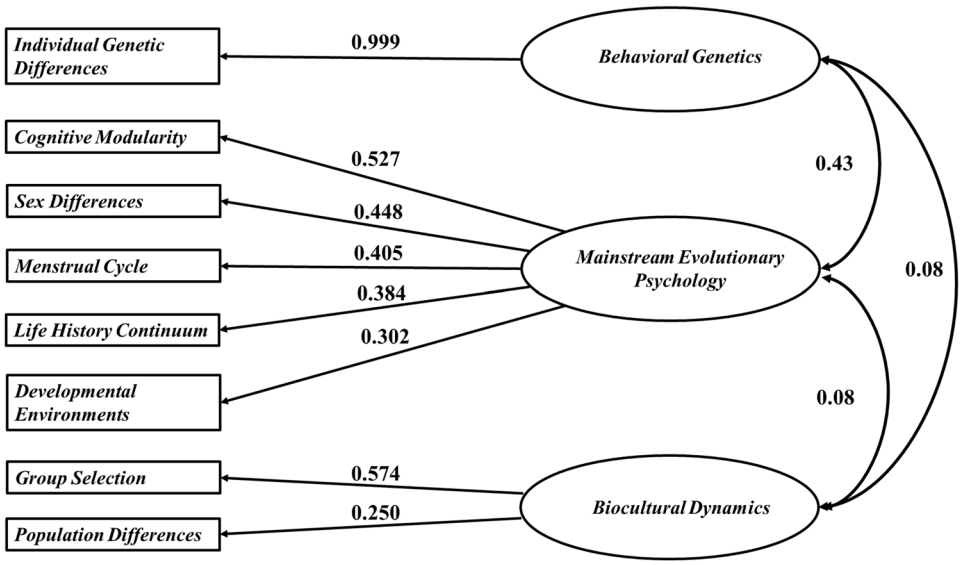

Fig. 1 Factor structure with correlated factors among items onto which the three belief-cluster factors load preferentially (cross-loadings not shown)

SEQCA with Factor Scores

As indicated in Table 3, the SEQCA reached statistical significance (as evidenced by the Pillai-Bartlett V statistic), although the model explained only a small proportion of the variance (13%). The first step of the model employing the corresponding contrasts as predictors of the *Biocultural Dynamics* factor revealed that the first contrast was a positive and statistically significant predictor, suggesting that participants who did not have any training in either psychology or anthropology scored higher on this latent dimension than participants who had either psychological or anthropological training. The second contrast was not statistically significant. In the model's second step, the *Biocultural Dynamics* factor positively and significantly predicted the *Mainstream Evolutionary Psychology* factor. Although the first contrast (*no psychological training* and *no anthropological training* vs. *psychological training* or *anthropological training*) was not statistically significant, the second contrast (*psychological training* vs. *anthropological training*) was a positive and statistically significant predictor. This result indicates that psychologists, relative to anthropologists, more strongly endorse the items comprising the second dimension. In the last step of the model, the *Mainstream Evolutionary Psychology* factor positively and significantly predicted the *Behavioral Genetics* factor. None of the contrasts predicted the latter latent dimension.

Discussion

The results of the EFA indicate the presence of three distinct latent belief clusters. *Behavioral Genetics* is essentially its own latent variable loading (primarily) onto beliefs concerning the role of genetic variation in conditioning individual differences. The label *Mainstream Evolutionary Psychology* was chosen to designate the second factor, as this factor prominently incorporates beliefs concerning many key research themes that emerged from the SBS, such as the importance of massive modularity and sexual selection, and the role of the menstrual cycle in female mate choice variation. This factor also subsumes beliefs related to the existence of a latent life history factor and the effect of developmental environments on adult behavior, indicating that endorsers of this belief cluster are quite adaptive, as much of the human-relevant research associated with these evolutionary-theoretical developments postdates the "founding" of SBS evolutionary

Table 3 SEQCA (type I sum of squares (SS)) exploring psychological and anthropological training status as predictors of the factor scores of each latent dimension. The reference category corresponds to individuals who did not have psychological or anthropological training

Overall	E^2	***95%CI***	***F*-value**	***p*-value**
$V = 0.053$	0.13	0.05,0.21	5.25	< 0.0001
***Y* variable: biocultural dynamics**				
Predictors	***sR***	**95%CI**	***F*-value**	***p*-value**
Contrast 1	0.16	0.08,0.24	16.05	< 0.0001
Contrast 2	− 0.01	− 0.09,0.07	0.06	0.8
***Y* variable: mainstream evolutionary psychology**				
Predictors	***sR***	**95%CI**	***F*-value**	***p*-value**
Prior *Y* variable				
Biocultural dynamics	0.08	0.00,0.16	4.23	0.04
***X* variables**				
Contrast 1	− 0.03	− 0.11,0.05	0.56	0.46
Contrast 2	0.15	0.07,0.23	14.02	0.0002
***Y* variable: behavioral genetics**				
Predictors	***sR***	**95%CI**	***F*-value**	***p*-value**
Prior *Y* variables				
Mainstream evolutionary psychology	0.43	0.36,0.49	127.99	< 0.0001
Biocultural dynamics	0.05	− 0.03, 0.13	1.61	0.2
***X* variables**				
Contrast 1	0.04	− 0.04,0.12	1.10	0.29
Contrast 2	0.00	− 0.08, 0.08	0.00	0.9

Contrast 1: no psychology training and no anthropology training (+ 2) compared to psychology training (− 1) or anthropology training (− 1). Contrast 2: psychology training (+ 1) or anthropology training (− 1)

psychology (Barkow et al., 1992). The last, and by far the most isolated, factor is termed *Biocultural Dynamics*, as it captures what can be broadly described as group-level processes. These would include the existence of (evolutionarily meaningful) population-level differences and the action of group-level forms of selection (such as cultural group and multi-level selection). The relatively isolated nature of this factor is consistent with Egeland's (2023) observation that group and multi-level selection theories, along with the idea of recent human evolution (which might entail the relatively recent emergence of certain genetically or epigenetically influenced behavioral group differences; Frost, 2011), are major sources of controversy within evolutionary psychology.

These factors are all positively intercorrelated, with the association between the first and second factors being of quite high magnitude by the standards of psychological science (mean r for psychology = 0.2 (Gignac & Szodorai, 2016) vs. 0.43 in the case of this association). The majority of the inter-factor correlations (two out of three) are of comparatively small magnitude, however. Although this positive inter-factor correlation structure might be taken as evidence that there is substantial agreement among evolutionary psychologists on these controversial matters, the coherence was not sufficiently strong to yield a distinct and superordinate *Core Beliefs* factor, which would have indicated the existence of a distinct metatheory within what can be broadly termed evolutionary psychology.

Participants reporting no training in either psychology or anthropology endorsed the items comprising the *Biocultural Dynamics* factor to a greater degree than participants with training in either of these fields. This suggests that training in psychology or anthropology might inhibit belief in the evolutionary significance of aggregate differences between populations, or of the outcomes of group-level interactions, perhaps via preferential focus on human universals and/or gene-centered models of selection. Endorsement of the *Biocultural Dynamics* factor very weakly (and positively) but significantly predicted the *Mainstream Evolutionary Psychology* factor (consistent with the inter-factor correlation detected in the EFA). Net of this, the first contrast (*no psychological training* and *no anthropological training* vs. *psychological training* or *anthropological training*) did not predict endorsement of the *Mainstream Evolutionary Psychology* factor, but the second contrast (*psychological training* vs. *anthropological training*) was a positive and statistically significant predictor. This result indicates that psychologists, relative to anthropologists, endorse the second dimension to a greater degree. This finding might result in part from the fact that some of the key themes associated with the *Mainstream Evolutionary Psychology* factor are closely related to a number of different areas of psychology, such as cognitive psychology (e.g., through massive modularity), and differential and developmental psychology (e.g., through biometric and psychometric life history theory). Finally, the *Mainstream Evolutionary Psychology* factor positively and significantly predicted the *Behavioral Genetics* factor (again consistent with the findings of the EFA), but none of the contrasts predicted the latter latent dimension net of the former. This indicates that endorsement of the *Behavioral Genetics* factor is unrelated to disciplinary background.

Overall, these results may support Egeland's (2023) thesis, specifically that evolutionary psychology, broadly speaking, lacks a coherent hard core, and is instead characterized by competing theoretical perspectives. The "core beliefs" identified by Kruger et al. (2023) seem to lack the internal consistency necessary to evidence a unified research program. Moreover, these beliefs arguably are not distinct from the hard core of evolutionary biology itself. It could be maintained that the only kind of research that should be called "evolutionary psychology" depends on the beliefs that cluster with the second factor and is exclusive of at least some of the beliefs associated with the *Biocultural Dynamics* factor. The second factor has been designated the *Mainstream Evolutionary Psychology* factor because a number of its constituent beliefs correspond to those of the SBS of evolutionary psychology (as articulated by Tooby and Cosmides (2005)). Pinker (2018) seems to imply that the SBS is the only legitimate form of evolutionary psychology, where he states that group selection theory "contrasts with mainstream evolutionary psychology, in which the unit of selection is the gene" (p. 448), thus usefully highlighting a key tension between this factor and the *Biocultural Dynamics* one (which incorporates belief in group selection).

But the idea that the SBS constitutes the "one true" evolutionary psychology is problematic. As per Egeland (2023), the SBS's assumptions are simultaneously too broad (in that many of them are basic to evolutionary biology) and too narrow (in that a number of evolutionary researchers working on problems of human behavior and psychology strongly contest them). Egeland (2023) suggests that philosophically grounding the metatheory of evolutionary psychology on these narrow and contested criteria would be like grounding social psychology on the reality of priming effects, which are notoriously difficult to reproduce in replication studies. It would be incorrect to claim that social psychology as a field fails because priming effects lack robustness. It would be similarly erroneous to assert that evolutionary psychology as a whole fails because of evidence against, e.g., massive modularity.

The idea that the SBS approach is (at least in part) theoretically independent from, and in tension with, other bodies of theory (such as those associated with the *Biocultural Dynamics* or *Behavioral Genetic* factors) is consistent with the "High" vs. "Broad Church" or "Evolutionary Psychology" vs. "evolutionary psychology" distinction that (as was noted

in the introduction) has been drawn by some researchers commenting on the state of the field (e.g., Buller, 2005; Dowens, 2021; Heyes, 2012; Woodley of Menie and Sarraf, 2018).

Egeland (2023) observes that the fact that broader evolutionary psychology apparently lacks an overarching and distinctive metatheory or hard core and is associated with debates concerning the status of various fundamental statements of theory should not be taken to demonstrate that it is a Kuhnian "pre-paradigm" science. Rather, he argues that it should be understood as a "pre-normal" science. Consistent with this is the presence of positively signed correlations between the three factors suggesting that there is considerable potential for the future development of a coherent unifying research program. For example, the substantive correlation between the *Mainstream Evolutionary Psychology* and *Behavioral Genetics* factors may imply that evolutionarily informed models of individual-differences genetics are becoming much more widely accepted among those endorsing *Mainstream Evolutionary Psychology* (see Barbaro and Penke (2021) and Luoto and Woodley of Menie (2022) for further discussion of the status of this fruitful integration). As this consolidation process continues, it is predicted that the *Behavioral Genetics* factor will cease to be distinct in future studies of this kind.

Integration with the *Biocultural Dynamics* factor by contrast is likely a long way off. Rapprochement between research groups identifying strongly with either *Mainstream Evolutionary Psychology or Biocultural Dynamics* might be achieved by more careful and critical examination of the bases for rejecting multilevel selection theory that some prominent evolutionary psychologists have offered (for discussion, see Eldakar and Wilson (2011; Gintis (2017)), as well as further testing of recent bodies of theory associated with the *Biocultural Dynamics* factor (such as social biogeography (Figueredo et al., 2021; Garcia, 2017) and multilevel selection (Bowles & Gintis, 2011; Jones, 2018; Hertler et al., 2020). The topic of behavioral population differences is unlikely to lose its controversial status in the foreseeable future—while debate is ongoing, recent research informed by molecular-genetic data has provided evidence for environmental rather than evolutionary-genetic explanations of such differences (Peñaherrera-Aguirre et al., 2022). In light of these findings, evolutionary psychology, as a pre-normal science, might be described as having a *soft core*, which is in the process of hardening as it advances toward the status of a mature, or "normal," science.

One potential objection to the above results could be raised by noting that Kruger et al. (2023) specifically surveyed controversial beliefs, and that by their nature, such beliefs will occasion disagreement, leading inevitably to lack of coherence between belief clusters. It is important to note, however, that many of the topics surveyed by Kruger et al. have *foundational* significance for evolutionary psychology. The very fact that despite this they are *still* thought controversial could just as easily be interpreted as evidence for the idea that the field lacks a well-developed metatheory, which suggests that there may be no truly uncontroversial beliefs within evolutionary psychology that are idiosyncratic to it. As has been noted already, the sorts of things that evolutionary psychologists would doubtlessly universally agree upon (and would therefore *not* find controversial) are not particularly distinctive with respect to the broader field of evolutionary biology, such as the latter's Modern Synthesis (MS).

Nonetheless, one could take a rather different stance from that of Egeland (2023) with respect to what features a science must have to be considered developed. It seems that a Lakatosian view expects scientific fields to often have multiple incompatible research programs—although a dominant one is typically if not always in place in the most thoroughly mature sciences, there may be significant competing research programs in domains in which "normal science" is clearly occurring. For example, in evolutionary biology itself, even applied just to non-human animal taxa, there is still great controversy over the levels of selection, life history theory, and sexual selection, as well as the nature of individual and population differences in behavior, all with associated "camps" or "schools." A surprisingly large number of evolutionary biologists are even calling for something as radical as an "extended evolutionary synthesis" (EES) to supersede the established MS, occasioning much controversy (see Müller, 2017; Vidya et al., 2023); it remains to be seen whether the MS and EES proponents will remain in (potentially) competing research programs or whether this marks the beginning of a crisis that will end in a Kuhnian scientific revolution or something similar). But it does not seem reasonable to argue that evolutionary biology is not a mature or normal science—perhaps it is not as mature as most areas of research in physics and chemistry, but neither is it (clearly) in the pre-normal stage.

That notwithstanding, it is definitely significant that evolutionary psychologists have failed to identify a metatheory other than evolutionary biology's MS. Evolutionary psychologists potentially could counter that their field should *not* be understood as meaningfully distinct from evolutionary biology—it is simply evolutionary biology applied to human behavior and psychology. The persuasiveness of this hypothetical rejoinder will not be considered here. It is sufficient to note that for those who would classify evolutionary psychology as a meaningfully independent field, the lack of a *distinct* metatheory or hard core (with a changing and currently rather pluralistic soft core in its place) seems to be a reasonable basis for classifying it as a pre-normal science.

It should be finally noted that the three belief clusters identified in the current work must not be taken to indicate that only three such clusters exist. There could well be more. Future surveys ought to aim to evaluate beliefs with respect to

a larger array of potential topics. These might include issues related to the commensurability of measures of behavior and cognition in humans and non-human animals, which is a very controversial research topic in comparative psychology that has direct implications for (human) evolutionary psychology (Burkhart et al., 2017). Using political beliefs and worldviews as additional predictors of patterns of endorsement in future work might also yield novel insights into the sociological causes of belief clustering in this research community.

Author Contribution MAW devised the analysis and drafted the manuscript. MPA conducted all analyses. MAS provided philosophical expertise and contributed to the drafting of the text. CS provided the data. DK provided the data.

Data Availability Data will be made available upon request.

Code Availability The R code will be made available upon request.

Declarations

Ethics Approval The project was reviewed by the University of Michigan's Institutional Review Board for Health and Behavioral Sciences prior to data collection.

Consent to Participate Participants completed a consent form before proceeding with the rest of the study.

Consent for Publication All authors on this project consent to publication.

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