

Dreams, problem-solving, and resilience in Chinese adults

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Summary. Anecdotal stories about the effects of dreaming on problem-solving and resilience or the relationship between them have been reported throughout human history. Empirical research about dreaming has since confirmed that relationships between these constructs exist, although further research is needed. This study investigated correlations between dream variables (attitude toward dreams, dream intensity, dream quantity, dream vividness, and altered dream episodes) and problem-solving and resilience variables, as well as the prediction of problem-solving and resilience variables by dream variables. Data came from an online survey in Hong Kong answered by 233 young people of Chinese ethnicity (ages 16-38, $M = 21.90$, $SD = 3.78$), and included the Attitude Toward Dreams Scale, Dream Intensity Scale-Revised, Resilience Scale-14, and items measuring problem-solving. Data analyses included Pearson correlations, multiple regression, and mediation analyses. Dream vividness (sensory and emotional experiences in dreams) or altered dream episodes (dream lucidity) significantly and positively affect conscious problem-solving. In contrast, dream intensity (an aggregate magnitude of subjective dream experiences) and dream quantity (dream recall frequency concerning dream activities such as dream awareness, dream content, and nightmares) significantly and negatively affect resilience. Furthermore, dream variables must first act indirectly upon problem-solving for positive changes in resilience to occur. Although attitude toward dreams does not directly affect problem-solving or resilience, it has an indirect effect through dream intensity and its three dimensions (dream quantity, dream vividness, and altered dream episodes), which, in turn, indirectly effect either problem-solving or resilience. Importantly, these results indicate a direct effect of some dream variables on problem-solving and on resilience, and indicate the process or sequence of their indirect effects, although correlation does not necessarily imply causation, and possible explanations for these findings require investigation.

Keywords: Dreams, Dream Intensity Scale-Revised, problem-solving, resilience

1. Introduction

The study discussed herein investigates relationships between dreams, problem-solving, and resilience. Problem-solving—the process of defining a problem, identifying courses of action and goals, and implementing and evaluating solutions—has mostly been studied in psychology in relation to conscious mental processes. Yet, there is evidence that unconscious processes which typically operate outside an individual's explicit awareness, such as in dreaming, can influence thoughts, feelings and behaviors in conscious problem-solving (Barrett, 2001; Cartwright, 1974; Pagel & Vann, 1992; Schredl, 2000; White & Taytroe, 2003). Indeed, the proposition that dreams can provide insight or direction for waking life and its challenges is not new, as shown in anecdotal stories throughout human history by artists, inventors, scientists, writers, and others (Barrett, 2001; Diamond, 1963; Ellis, 1911; Freud, 1900; Van de Castle, 1994). For example, in 1865, August Kekulé, a German organic chem-

ist, figured out the structure of benzene, an organic chemical compound, after dreaming about gambolling atoms and molecules that arranged themselves in a snake-like motion whereby a snake had seized hold of its own tail, which Kekulé later interpreted when awake to signify a hexagonal ring of six tetravalent carbon atoms, the Kekulé structure of benzene (Barrett, 2001; Diamond, 1963). In 1871, Dmitri Mendeleev, a Russian chemist, dreamt a visualisation of the Periodic Table of the Elements, now widely used in science (Barrett, 2001). To cite a more recent example, Stephen King, the American novelist well known for horror fiction in the late 20th century, credits his dreams for providing some of the ideas and scenes in his works (Epel, 1993). There are many more examples of dream-inspired creative works throughout history, for example, by Paul McCartney, Salvador Dalí, and William Blake, to name just a few (e.g., Epel, 1993; Roklicer, 2023; The Dalí, 2023).

Relationships between dreaming and problem-solving have since been reported in empirical research (Barrett, 1993; Cartwright, 1974; White & Taytroe, 2003; Pagel & Vann, 1992; Schredl 2000). While any kind of problem can potentially be solved during dreaming, dreams tend to be much better for finding solutions to problems that involve thinking imaginatively using original ideas (Barrett, 2017, 2020). Dreams are especially useful when solutions can be visualized, since the secondary visual cortex, associated with image formation, is more active during REM sleep when dreams are more prevalent, and since the dorsolateral prefrontal cortex, associated with volitional, logical, and social-

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ly appropriate thinking, becomes less active (Barrett, 2017, 2020). As a result of these discoveries, various techniques such as dream incubation or lucid dreaming induction have been developed to assist individuals in focusing attention on specific problems prior to sleep in the expectation that dream processes might aid problem resolution (e.g., Barrett, 1993; White & Taytroe, 2003; Olsen, Schredl & Carlsson, 2020). Another way dreams can help us to problem solve is in therapy, whereby conscious insight into dream content reveals that which is buried in the subconscious (e.g., Eudell-Simmons & Hilsenroth, 2007). However, it is important to differentiate solving problems in the dreaming mind, that gives one an insight into a waking life problem, from gaining insight into problems residing in the subconscious through analysing dream content while awake.

In addition, lucid dreams, in which the dreamer is aware that they are dreaming and in which they can possibility influence dream content, can help with waking life problems. For example, preliminary findings reported by Stumbrys and Daniels (2010) suggest that lucid dreams can contribute to problem-solving when dealing with a more creative task (i.e., creating a metaphor for a specified situation) than with a logical task (i.e., solving a logical puzzle). In another study, Schädlich and Erlacher (2012) asked 301 lucid dreamers about the specific purposes of their lucid dreams, and found that more than a quarter had used them to solve a particular problem (29.9% of the participants), such as a work-related problem or an academic problem or a conflict with others. A similar proportion of participants had used them to gain creative ideas or insights (27.6%), although lucid dreaming was mostly used for having fun (81.4%). However, a recent study of dreaming by Chinese university students in Hong Kong found very few relationships between self-reported dream variables and perceived abilities to solve problems and challenges (Yu & Wong, 2020). This finding might be due to subjective reports being used in place of objective measures to determine the success of the participants' problem-solving, and warrants further research in Chinese societies using alternative measures of problem-solving.

The related construct of resilience can be defined as an individual's adaptability, perseverance, resourcefulness, and self-reliance on their capabilities during adversity or unplanned events (Wagnild & Young, 1993). There has been very little empirical research on dreaming and resilience, although resilience and problem-solving are not always clearly differentiated in the literature (e.g., Barrett, 1993, 2001). For example, creative thinking during sleep does not mean the same as solving a problem. Indeed, anecdotal stories throughout history about the contribution of dreams to creativity and inspiration in waking art, language, math, music, writing, and inventions and discoveries (Barrett, 2001; Diamond, 1963; Van de Castle, 1994), such as those mentioned above, are particularly relevant to resilience as they show how people have surmounted challenges in life through imagination and resourcefulness. Empirical research suggests that dreams which stimulate waking-life creativity can play a considerable role in people's lives including providing the impetus to do something that the dreamer otherwise has difficulty doing (Schredl & Erlacher, 2007). It has been suggested that dreams can even be simulations of waking reality which enable dreamers to think-through and to rehearse challenges in life and to develop and strengthen positive social skills that can be drawn upon in waking life (Revonsuo, Tuominen, & Valli, 2015). This can include the

simulation of emotional states and concerns (Revonsuo et al. 2015), as it is well known that dreams can play a role in emotional regulation and in coping with negative emotions experienced during wakefulness (Cartwright, 2005). It is also thought that dreams can simulate threatening waking events and enemies, enabling the dreamer to rehearse and to develop skills associated with threat perception and threat avoidance behaviours and strategies, especially in nightmares, bad dreams, and post-traumatic dreams, but also in other types of dreams (Revonsuo et al. 2015).

There is initial evidence suggesting that lucid dreams can facilitate resilience (Green & McCreery, 1994; Soffer-Dudek, Wertheim, & Shahar, 2011), for example, by recreating scenarios which one can manage in a safe setting, and by enhancing a sense of agency in waking life (Schädlich & Erlacher 2012). Lucid dreams have been incorporated into psychotherapy for self-healing and growth and in treatments such as lucid dream induction for the treatment of nightmares and traumas (Spoormaker, Van den Bout, & Meijer, 2003; Tholey, 1988; Zadra & Pihl 1997). Yu and Wong's (2020) study in a Hong Kong Chinese sample found that while dream lucidity correlated positively with resilience, the frequency or quantity of regular dreams did not associate with resilience, suggesting that it is the lucidness or self-awareness of dreaming that might be implicated in recovery from adversity rather than the overall intensity or quantity of dream experiences. However, a great deal of the work about dreaming and resilience in the literature remains either theoretical and speculative or exploratory and preliminary with historical anecdotes, pilot studies (e.g., Spoormaker & van den Bout, 2006), small sample sizes (e.g., Zadra & Pihl, 1997), and indiscriminate between problem-solving and resilience (e.g., Barrett, 2001).

Any dream variable, including variables already extensively studied in dream research such as dream recall frequency, will capture only part of the unconscious activities during dreaming relevant to problem-solving or resilience. Therefore, in this study, we examine the possible relationships between problem-solving or resilience and a wider variety of subjective dream-related activities and experiences, specifically, those quantified by the Dream Intensity Scale (Yu, 2008, 2010, 2012) that was developed to measure the quantitative and qualitative experiences of dreaming within four major dimensions (dream quantity, dream vividness, diffusion, altered dream episodes), defined in Table 1. The aggregate magnitude of subjective dream experiences in these four dimensions, as measured by the Dream Intensity Scale Revised, can be consolidated and conceptualized as 'dream intensity', a multifaceted and hybrid construct (Yu, 2008, 2010, 2012). In addition to investigating these dream variables, the present study also measures attitude toward dreams, defined as the way that an individual thinks and feels about and evaluates dreams.

It is also important to differentiate clearly between problem-solving, which concerns developing, executing, and evaluating solutions after identifying and defining a problem, and resilience, which is more about an individual's uniqueness, adaptability, competence, and perseverance, as well as their self-reliance—an individual's adaptive coping ability to overcome or to 'bounce back' from adversity (Ang et al. 2022; Wagnild & Young, 1993). This definition of problem-solving, which is more about its actual process, can be regarded as an alternative conceptualisation to in Yu and Wong's (2020) study that measured problem-solving in

Table 1. Dimensions measured by the Dream Intensity Scale Revised (Yu, 2010, 2012).

Dimension	Definition
Dream Quantity	Regular dream activities including the frequencies of dream awareness, main content of dreams, nightmares, and multiple dreams in a single night.
Dream Vividness	Sensory and emotional experiences during dreaming, for example smelling something or feeling emotions in dreams.
Altered Dream Episodes	Dream lucidity based on the incidence of altered forms of dream experiences (e.g., awareness of being in a dream, reexperience of wishful dreams).
Diffusion	Cognitive distortion that involves the transference of psychological values (e.g., condensation, dream-reality confusion), for instance difficulty distinguishing between real-life memories and dreamed events or fantasies.

terms of personal enjoyment and accomplishment and yet found very few relationships with self-reported dream variables. In the literature, problem-solving has been included as one component that is important for resilience. It is assumed that effective problem-solving skills support individuals to address or to adjust to the challenges in their lives, thereby moderating or mediating the effects of stressors on emotional distress and on well-being (Helmreich et al. 2017; Nezu 2013). Therefore, the development of problem-solving skills is an important part of some resilience training programs or resilience-based interventions (e.g., Ang et al. 2022; Tenhula et al. 2014; Nezu 2013).

Specifically, this study investigates correlations between different dream variables (attitude toward dreams, dream intensity, dream quantity, dream vividness, and altered dream episodes), problem-solving, and resilience, and the prediction of problem-solving and resilience by dream variables, in Chinese adults in Hong Kong. Based on the literature reviewed above, it was hypothesized that there would be positive and significant relationships between attitude toward dreams, dream intensity (or its three dimensions—dream quantity, dream vividness, altered dream episodes) and problem-solving or resilience (Hypothesis 1). It was also hypothesized that dream variables would significantly predict problem-solving or resilience (Hypothesis 2). Furthermore, the study included a mediation analysis to identify any dream variables important in predicting problem-solving and resilience, and the mechanisms by which they operate. Accordingly, it was hypothesized that associations between attitude toward dreams and resilience were mediated by dream intensity (or by its dimensions—dream quantity, dream vividness, and altered dream episodes) and by problem-solving (Hypothesis 3). This hypothesis implied that although a positive attitude toward dreams might not be directly related to problem-solving and resilience, it might have an indirect impact through its effect on dream intensity.

2. Method

2.1. Location and participants

The study was conducted in Hong Kong, a Special Administrative Region of China, with a convenience sample of 233 adults of Chinese ethnicity ($M = 21.90$, $SD = 3.78$, $Range = 16-38$ years old); the sample's demographic char-

acteristics are shown in Table 2. Incomplete survey responses, and surveys which took less than 300 seconds to complete, were excluded from the dataset.

2.2. Measures

The survey consisted of the following measures of dream, problem-solving, and resilience variables.

Attitude Toward Dreams. Six items measured attitude toward dreams: 'I am interested in the dream topic', 'I think that dreams are meaningful', 'I want to know more about dreams', 'If somebody can recall and interpret his/her dreams, his/her life will be enriched', 'I think that dreaming is in general a very interesting phenomenon', and 'A person who reflects on her/his dreams is certainly able to learn more about herself or himself' (Schredl, Rieger, & Göritz, 2019). Each item was coded as *not at all* (0), *not that much* (1), *partly* (2), *somewhat* (3), and *totally agree* (4), on a 5-point Likert scale. The total score was computed as a mean of the six items, and a higher score indicates a more positive attitude toward dreams. The Cronbach's α was .834, in agreement with previous studies (Schredl et al. 2019).

Dream Intensity Scale-Revised. This 23-item scale (Yu, 2008, 2010, 2012) measured the quantitative and qualitative experiences of dreaming in four dimensions, namely, dream quantity, dream vividness, diffusion, and altered dream episodes (Table 1). It includes two items which assess the incidence of lucid forms of dream experiences (i.e., 'Have you ever become aware or known during a dream that "you are dreaming?"', 'Have you ever been able to control the contents of your dreams and make things happen in them at will?'). Participants indicated frequencies on a 10-point absolute scale, and a higher total score indicates more intense dream experiences. The Cronbach's α coefficient of all items was .833, and the α coefficients for each dimension ranged .571 (diffusion) to .793 (dream quantity), similar to previous work (Yu, 2008, 2010, 2012). Since the reliability of the diffusion dimension was low in this study, and the role of this dream variable was not theoretically substantive in the hypothesized mediation models, it was not analyzed as a standalone subscale.

Resilience Scale-14. A 14-item scale designed for adolescents (Wagnild & Young, 1993), and adapted to the Hong Kong Chinese context (Chung et al., 2020), was used to measure resilience as two dimensions, Personal Competence and Acceptance of Self and Life. Example scale items include 'When I am in a difficult situation, I can usually

Table 2. Demographic characteristics of the sample.

Factor	n = 233	Mean (SD)	Percentage	Cumulative Percentage
Sex				
Female	155		66.5	66.5
Male	78		33.5	100
Age	233	21.90 (3.78)	100	100
Employment Status				
Student	192		82.4	82.4
Employed	40		17.2	99.6
Unemployed	1		.5	100
Education Level				
Junior Secondary School	1		.4	.4
Senior Secondary School	7		3.0	3.4
Diploma/associate degree	19		8.2	11.6
Bachelor degree	195		83.7	95.3
Master degree or above	11		4.7	100

find my way out of it' (Personal Competence), and 'I usually take things in stride' (Acceptance of Self and Life). Each item was answered on a 7-point Likert scale, and anchored strongly disagree (1) to strongly agree (7). The total score ranged from 14 to 98, and a higher score indicates higher resilience. Cronbach's α coefficient was .871.

Problem-solving. Problem-solving was measured using twelve items about identifying and defining a problem and its causes, and about developing, executing, and evaluating solutions (e.g., 'I always think carefully before making a decision', 'I believe that every problem has a solution'). Items were coded on a 3-point Likert scale (1 = False, 2 = Rather True, 3 = True). A higher score indicates a greater focus on problems and on achieving a solution. Cronbach's α was .696.

Demographic variables. Sex, age, education level, and employment status were measured.

2.3. Procedure

The sample was recruited via an advertisement communicated on the internet and by email within the first author's university and also beyond the campus. The survey was available in both Chinese and English, official languages in Hong Kong. It was completed online, at a time and location convenient to each participant, and individually, anonymously, voluntarily (without payment), after reading information about the study and after giving informed consent. The study underwent ethical review and approval by a research ethics committee in the first author's university.

2.4. Data analyses

The major model hypothesized for testing in this study consisted of two serial mediators: dream intensity and problem-solving. A priori power calculation was conducted in accordance with Schoemann, Boulton, and Short (2017), which resulted in an appropriate minimum sample-size of 176 (target power=0.8, LLC .80, ULC .84, actual power achieved=0.82). Therefore, the actual sample size of 233 was considered adequate for testing the model. Prior to analyses, data were screened for outliers and acquies-

cence. Pearson correlation r examined associations between the scores of each measure, and multiple regression tested the prediction of specific variables by other variables, analyzed in SPSS (version 26). Mediation analysis was conducted using PROCESS macro (version 3.5.3) for SPSS (Hayes, 2020, 2022). Reliability of measures was assessed with Cronbach's α .

3. Results

3.1. Correlations among variables

Table 3 shows Pearson correlations between dream, problem-solving, and resilience variables. Attitude toward dreams is not significantly correlated with problem-solving or with resilience. Dream intensity is significantly and positively correlated with problem-solving, but not with resilience. Considering the specific dimensions of the Dream Intensity Scale, dream vividness and altered dream episodes are each significantly and positively correlated with problem-solving, whereas dream quantity is not. There is a significant negative correlation between dream quantity and resilience, but no significant correlation between dream vividness and resilience or altered dream episodes and resilience. Although not a focus of the study, it is of interest

Table 3. Correlations between dream, problem-solving, and resilience variables.

Measure	Dream Intensity	Problem-solving	Resilience
Attitude toward dreams	.238***	.118	.048
Dream intensity		.166**	-.062
Dream quantity		.047	-.142**
Dream vividness		.207**	.044
Altered dream episodes		.151**	.008
Resilience		.410***	
Problem-solving			.410***

N = 233; ** P<.05; *** P<.001

Table 4. Multiple regression of problem-solving as the outcome variable.

Variable	B	b SE	B	R ²	F	95% CI	
						LL	UL
<i>Model 1</i>				.207***	19.979***		
Attitude toward dreams	.050	.055	.056			-.058	.159
Dream intensity	.034	.011	.178***			.011	.056
Resilience	.119	.017	.418***			.086	.152
<i>Model 2</i>				.209***	15.054***		
Attitude toward dreams	.045	.055	.050			-.064	.154
Resilience	.116	.019	.408***			.082	.149
Dream quantity	.023	.027	.053			-.030	.076
Dream vividness	.154	.060	.162*			.036	.273
<i>Model 3</i>				.196***	18.617***		
Attitude toward dreams	.072	.054	.79			-.035	.179
Resilience	.115	.017	.405***			.082	.148
Altered dream episodes	.063	.028	.137*			.009	.118

Note. N = 233. *p < .05; **p < .01; ***p < .001.

to note that attitude toward dreams is positively correlated with dream intensity and its dimensions (dream quantity, $r = .151$, $p = .022$, dream vividness, $r = .253$, $p = .001$, and altered dream episodes, $r = .140$, $p = .033$), and that problem-solving and resilience are positively correlated.

3.2. Multiple regression

Multiple regression analyses were conducted to identify significant predictors of problem-solving and resilience respectively. Separate analyses were run for each dimension of the Dream Intensity Scale.

Regarding the prediction of problem-solving (Table 4), all regression models are significant and show similar directions as in the correlation analysis. Specifically, the first regression model found that dream intensity and resilience but not attitude toward dreams are significant predictors of

problem-solving, $F(3, 229) = 19.979$, $p < .001$, $R^2 = .207$. In the second regression analysis, dream vividness and resilience are significant predictors of problem-solving, whereas dream quantity and attitude toward dreams are not, $F(4, 228) = 15.054$, $p < .001$, $R^2 = .209$. The third regression analysis shows that altered dream episodes and resilience but not attitude toward dreams are significant predictors of problem-solving, $F(4, 228) = 14.201$, $p < .001$, $R^2 = .199$.

All regression models concerning the prediction of resilience (Table 5) are also significant and in agreement with the correlation analysis. The first regression analysis showed that dream intensity and problem-solving but not attitude toward dreams are significant predictors, $F(3, 229) = 17.457$, $p < .001$, $R^2 = .186$. The second regression model showed that dream quantity and problem-solving are significant predictors, whereas attitude toward dreams and dream vividness are not significant predictors, $F(4, 228) = 13.780$,

Table 5. Multiple regression of resilience as the outcome variable.

Variable	B	b SE	B	R ²	F	95% CI	
						LL	UL
<i>Model 1</i>				.186	17.457***		
Attitude toward dreams	.098	.196	.031			-.289	.485
Dream intensity	-.093	.041	-.140*			-.174	-.012
Problem-solving	1.511	.213	.429***			1.091	1.932
<i>Model 2</i>				.195	13.780***		
Attitude toward dreams	.078	.197	.025			-.310	.466
Dream quantity	-.252	.095	-.165**			-.439	-.065
Dream vividness	-.010	.217	-.003			-.437	.416
Problem-solving	1.461	.214	.415***			1.039	1.884
<i>Model 3</i>				.171	15.749***		
Attitude toward dreams	.021	.195	.007			-.362	.404
Altered dream episodes	-.092	.100	-.056			-.288	.105
Problem-solving	1.469	.215	.418***			1.045	1.894

Note. N = 233. *p < .05; **p < .01; ***p < .001.

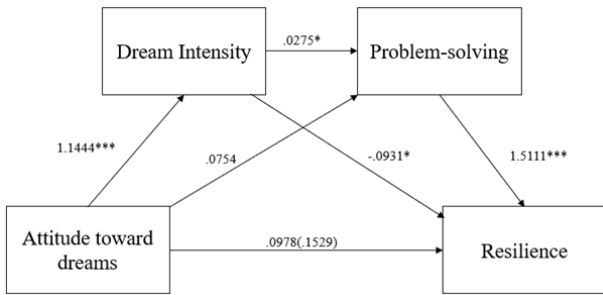


Figure 1. Standardised regression coefficients for the relationship between attitude toward dreams and resilience as mediated by dream intensity and problem-solving. Note. N = 233, *p < .05.; **p < .01.; ***p < .001.

p < .001, R² = .195. The third regression model showed that only problem-solving significantly predicted resilience, F(3, 229) = 15.749, p < .001, R² = .171.

3.3. Mediation analysis

A mediation analysis was conducted to contribute a better understanding of the relationships identified above. The first model examines the mediation of the association between attitude toward dreams and resilience by dream intensity and problem-solving (Figure 1). Dream intensity and problem-solving ($\beta = .0475$, bias-corrected and accelerated confidence interval [.0026, .1094]), and dream intensity by itself ($\beta = -.1065$, bias-corrected and accelerated confidence interval [-.2671, -.0050]) were significant mediators. However, the indirect effect of problem-solving alone was not significant ($\beta = .1140$, bias-corrected and accelerated confidence interval [-.0805, .3391]).

Since dream intensity is a multifaceted construct (Yu, 2012), mediation analyses were conducted with its three dimensions as mediators (Figure 2). There were significant indirect effects of dream quantity ($\beta = -.0790$, bias-corrected and accelerated confidence interval [-.2097, -.0054]), dream vividness and problem-solving ($\beta = .0553$, bias-corrected and accelerated confidence interval [.0123, .1173]) and dream quantity, dream vividness, and problem-solving ($\beta = .0093$, bias-corrected and accelerated confidence interval [.0009, .0233]).

Figure 3 depicts the mediation coefficients when altered dream episodes and problem-solving are mediators. The indirect effects of altered dream episodes and problem-

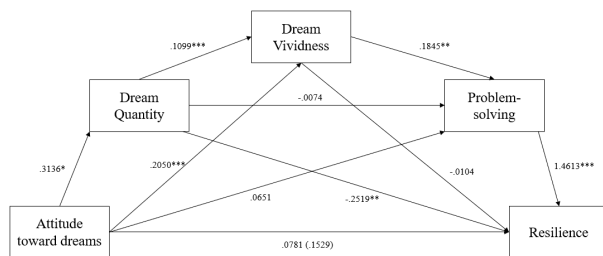


Figure 2. Standardised regression coefficients for the relationship between attitudes toward dreams and resilience as mediated by dream intensity dimensions and problem-solving. Note. N = 233, *p < .05.; **p < .01.; ***p < .001.

solving were significant ($\beta = .0256$, bias-corrected and accelerated confidence interval [.0003, .0687]). However, either altered dream episodes ($\beta = -.0252$, bias-corrected and accelerated confidence interval [-.1095, .0305]) or problem-solving alone ($\beta = .1315$, bias-corrected and accelerated confidence interval [-.0585, .3614]) was not a significant mediator.

4. Discussion

The results indicate a strong direct effect of some dream variables on problem-solving and on resilience and indicate the process or sequence of indirect effects of dream variables on problem-solving and resilience. Specifically, different dream variables show different associations with problem-solving or resilience variables. Of note, dream intensity is positively and significantly associated with problem-solving, showing its importance in this process, and yet negatively associated with resilience. Similarly, dream vividness and altered dream episodes variables are positively and significantly correlated with the problem-solving variable, but not with the resilience variable, revealing their importance in problem-solving but not in resilience. The significant and negative effect of dream intensity and dream quantity on resilience but not on problem-solving is a similarly important finding that helps us to understand their significance in these processes.

The mediation analysis provides further detail about the relationships between dream, problem-solving, and resilience variables. Specifically, although attitude toward dreams does not directly affect problem-solving or resilience, it positively predicts dream intensity and its three dimensions, which, in turn, might indirectly influence either problem-solving (i.e., dream vividness, altered dream episodes) or resilience (i.e., dream quantity). Importantly, these results indicate the process or sequence of indirect effects of dream variables on problem-solving, an original finding that is lacking in the literature. In particular, the significant and positive effects of dream vividness or altered dream episodes variables on problem-solving, and the non-significant effect of dream quantity on problem-solving, suggest that sensory dream experiences might influence conscious problem-solving. The importance of dream vividness in the analyses suggests that clear, powerful, and detailed mental images and meanings and sensory and emotional experiences in dreams are important for problem-solving, presumably because they have richer and more clearly perceptible content on which the dreamer can draw upon. Furthermore,

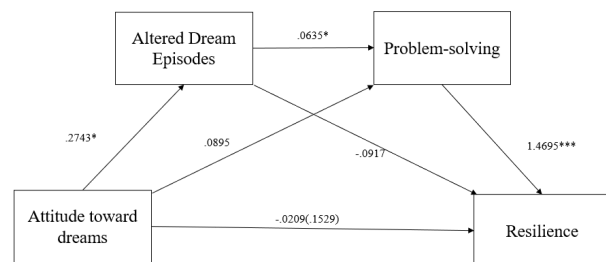


Figure 3. Standardised regression coefficients for the relationship between attitude toward dreams and resilience as mediated by altered dream episodes and problem-solving. Note. N = 233, *p < .05.; **p < .01.; ***p < .001.

the significance of the altered dream episodes variable implies that cognitive distortions in dreams, and awareness of being in a dream, might enable dreamers to move outside the constraints of waking mentality for problem-solving (Yu & Wong, 2020); this finding agrees with reports that lucid dreams might be especially associated with problem-solving, although lucid forms of dream experiences have been measured differently in different studies (Schädlich & Erlacher, 2012; Yu & Wong, 2020). Yet, dream quantity might still have a positive influence on problem-solving through its indirect effects on other dream variables which, in turn, are positively associated with problem-solving. That is, people who have more dreams also have more opportunities for experiencing dream vividness and altered dream episodes, as measured by the Dream Intensity Scale, which might then support problem-solving.

While our results contrast to Yu and Wong's (2020) conclusion that few dream variables are associated with problem-solving, they used a scale which focused more on the personal enjoyment and sense of accomplishment of solving problems. In contrast, our survey items are more about the problem-solving process itself.

These results provide further support for reports in the literature that dreams can play a role in problem-solving (Barrett, 1993; White & Taytroe, 2003; Olsen et al., 2020; Pagel & Vann, 1992; Schredl, 2000), and we can now see more clearly what it is about dreams—their specific dimensions and pathways—that could offer ways of enhancing or contributing to waking life problem-solving. While the strength of some of the relationships between dream and problem-solving and resilience variables in the final regression models and in the mediation figures suggest that relatively weak associations with problem-solving and resilience might sometimes be created in dreaming processes (as opposed, presumably, to strong and obvious ones that are more likely in waking processes or in problem-solving training in waking life), it is clear that dream intensity, dream vividness, and altered dream states at least offer ways of enhancing or contributing to waking life problem solving. Further research can investigate the 'why' for these relationships.

Perhaps surprising is the finding that dream intensity, especially dream quantity, significantly and negatively predicts resilience, meaning it might hinder an individual's dealings with adversity and challenges in life. The non-significant associations between other dream variables and resilience show that they also do not enhance resilience. This finding goes against the grain of the literature about the role of dreaming in adaption to and coping with the demands of daily life, trauma, and phobia (e.g., Barrett, 2001; Diamond, 1963; Ellis, 1911; Freud, 1900; Van de Castle, 1994). However, we did not consider the direct links between dreams, problem-solving, and resilience in those participants who actively consider or work with the content of their dreams, for example by actively relating to the content of their dreams by reflecting on them, and changing paths and behaviour on the basis of understanding why they dream what they do, which is likely when dreams will have a more direct effect on resilience. This is a limitation of the present study and serves as an idea for future studies.

It is also important to note that Yu and Wong (2020) reported that the frequency and intensity of dreams including lucid dreams did not associate with resilience. Our findings that dream vividness or altered dream episodes (or dream quantity acting on dream vividness; Figure 2) do not affect

resilience does not support an alternative argument that it is the qualitative richness of dreams rather than quantitative aspects that might indicate the degree to which a person can recover from adversity (Yu & Wong, 2020). Rather, the present study suggests that dream variables must act indirectly upon problem-solving first for positive changes in resilience to occur, so it is dreaming and problem-solving in combination rather than only dream variables directly which uplift resilience (indeed, the correlation and regression results suggest that dream variables and the problem-solving variable together explain a lot of the variability in resilience). This finding agrees with studies which suggest that effective problem solving skills may enhance an individual's resilience (Helmreich et al. 2017; Nezu 2013), and with studies that include of the development of problem-solving skills in resilience training programs and resilience-based interventions (e.g., Ang et al. 2022; Tenhula et al. 2014; Nezu 2013). Taking this further, we suggest that dreaming processes (e.g., dream intensity, dream vividness, and altered dream states) offer fertile ground for understanding these relationships.

Attitude toward dreams was significantly associated with dream intensity and its dimensions, perhaps because people who have more positive attitudes might take dream recall more seriously (Olsen et al., 2020). But it was not associated directly with problem-solving or resilience, suggesting that dream intensity and its dimensions rather than a person's attitude toward dreams are instead directly associated with problem-solving or resilience. However, there was a significant indirect effect of attitude toward dreams on resilience when sequentially connected to other dream variables. This might explain why previous work (e.g., Olsen et al., 2020) found a positive association between dream attitude and emotional problem-solving. Further research could explore whether additional extraneous variables (e.g., personality) might indirectly connect dream variables to problem-solving and/or resilience.

While problem-solving and resilience are positively correlated and predict each other, they associate differently with different dream variables, suggesting that they should be considered as separate constructs in dream research. However, it is important to appreciate that the research design is correlational and hence cannot give information on causality, and the causality may well be in the other direction from problem-solving and resilience to dream variables, rather than assuming that it is dream variables affecting or leading to the problem-solving and resilience variables. Alternative explanations for the findings cannot be ruled out. For example, the negative association between dream intensity and resilience might mean that people who are more stressed or less resilient might have more dream intensity and quantity, or that drawing upon dreams as a resource for resilience might become less important as people adapt more to real life challenges, since dreaming may serve a long-term adaptive function (Grieser, Greenberg, & Harrison, 1972). Also from a methodological viewpoint, future research should examine in detail the meaning and operationalization of both problem-solving and resilience in Chinese societies (e.g., cognitions about the collective self and group affiliations, face-making, guanxi, etc.; see Sun, 2012), including their similarities and differences, which might differ to the ways these constructs are conceptualized in Western cultures. Hong Kong is a modernized city with Chinese and Western influences which are likely to be relevant to solving problems and dealing with life's challenges. It is also pos-

sible that the measurement of objective outcomes of problem-solving, or specific types of problems (Barrett, 1993), might result in different findings. For example, since dreaming is an emotional experience for many people (Yu, 2008, 2010), and theorists have long proposed that it is involved in the downregulation of negative affect experienced during wakefulness (e.g., Cartwright, 2005; White & Taytroe, 2003), it might be that creative problems with an emotional attachment are helped more by dreaming than creative problems without a personal meaning, or that dreams fair better with solving creative problems such as metaphors than logical problems (Barrett, 1993; Stumbrys & Daniels, 2010; White & Taytroe, 2003). Since the Dream Intensity Scale measures only the frequencies and main content of regular dreams and bad dreams shared by most people, and not necessarily dreams that are meaningful in terms of problem-solving and resilience, further research can focus specifically on dreams particularly beneficial in decision-making or in solving emotional or non-emotional problems rather than all dreams (see Olsen et al., 2020).

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