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# Abrupt academic dishonesty: Pressure, opportunity, and deterrence

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ABSTRACT

The first objective of this study was to explore whether students would be involved in abrupt academic dishonesty (AAD) at high levels of perceived pressure and low levels of perceived opportunities to cheat. We used Cusp R software to fit a cusp catastrophe model to the student cheating data. We found that students involved in AAD experienced high/low levels of perceived pressure/opportunity to cheat. The findings yield valuable insights into how the complex and nonlinear forces of perceived pressure and opportunity push students towards AAD in the classroom. The second objective was to design an original low-effort warning post (WP) in learning management systems and test whether it would reduce AAD based on the perceived psychological costs of being exposed (i.e., being reported to the Office of Student Conduct). We found that WP significantly reduced AAD, thereby contributing to an original deterrence of AAD in the classroom.

## 1. Introduction

In the physical sciences (Castrigiano & Hayes, 2018, pp. 35–57; Stewart, 1981; Cobb, 1981), a cusp catastrophe model (Fig. 1) describes how changes in a dependent variable, "behavioral state," are related to the levels of two independent variables, known as the "splitting variable $\beta$" and "asymmetry variable $\alpha$" (Gilmore, 1993, pp. 94–105; Woodcock & Davis, 1980, pp. 31–58; Zeeman, 1976). We apply the model to social sciences (Deakin, 1980) and postulate that it may potentially describe abrupt academic dishonesty (AAD), the behavioral state, under certain conditions in the educational context. We define abrupt academic dishonesty (AAD) generically as a student suddenly involved in a cheating behavior such as a sudden deliberate use of someone else's original ideas or materials without acknowledging their source (Abdolmohammadi & Baker, 2007), a sudden false excuse to gain an assignment extension or deferment of an exam (Hensley, Kirkpatrick, & Burgoon, 2013), or a sudden giving or receiving of illegal aid from other persons or materials brought into offline or online classrooms (Emerson & Smith, 2022; Kelly, Smith, & Emerson, 2022; Sorgo, Vavdi, Cigler, & Kralj, 2015), and so on.

The Fraud Triangle is the underpinning of many prior studies on student cheating behaviors (e.g., Smith, Emerson, Haight, & Wood, 2022; Homer, 2020; Burke & Sanney, 2018; Becker, Connolly, Lentz, & Morrison, 2006). It consists of three elements: rationalization, perceived opportunity, and perceived pressure (Dorminey, Fleming, Kranacher, & Riley, 2012; Albrecht, Albrecht, Albrecht, & Zimbelman, 2019). Perceived pressure and opportunity are two elements of the Fraud Triangle that may influence AAD (Homer, 2020). For

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example, perceived pressure from parents or graduate schools to make good grades (Becker et al., 2006; Daumiller & Janke, 2020) and perceived opportunities to purchase exam questions and answers online (Emerson & Smith, 2022; Peterson, 2004) may induce AAD. We review the literature (Table 1) but find no study relating the two elements of the Fraud Triangle to AAD formulated on a cusp catastrophe model. Thus, we develop a relationship (Fig. 2) between the two elements, namely, perceived pressure (splitting variable $\beta$) and perceived opportunity (asymmetry variable $\alpha$), and AAD (the behavioral state) formulated on the cusp catastrophe model (Arnold, 2004, pp. 3–6; Poston & Stewart, 1996, pp. 174–176; Zeeman, 1976). Therefore, the first objective of this study was to explore whether students are involved in AAD at high levels of perceived pressure and low levels of opportunity (Hypothesis 1).

We used Grasman, van der Maas, and Wagenmakers' (2009) statistical Cusp R software to fit Equation #5 of the model (Cobb, 1981; Cobb & Ragade, 1978; Cobb & Watson, 1980; Cobb & Zacks, 1985) to the student-cheating data provided by Choo and Tan (2008). We found that the students were involved in ADD at high/low levels of perceived pressure/opportunity to cheat (Tables 3 and 4). This finding has several contributions, including that it provides the first empirical evidence on abrupt dishonesty behavior formulated on the cusp catastrophe model (Arnold, 2004, pp. 3–6; Poston & Stewart, 1996, pp. 174–176; Zeeman, 1976), and perceived pressure and opportunity of the Fraud Triangle (Smith et al., 2022; Homer, 2020; Dorminey et al., 2012; Albrecht, Albrecht, Albrecht, & Zimbelman, 2019), which yields valuable insights into how the complex and nonlinear forces of perceived pressure and opportunity push students towards AAD in the classroom by defining AAD as the behavioral state (Cobb, 1981; Cobb & Watson, 1980), perceived pressure as the splitting variable $\beta$ (Dorminey et al., 2012) and perceived opportunity as the asymmetry variable $\alpha$ (Smith et al., 2022).

Based on Ajzen's theory that students' perceived psychological costs of being exposed reduce their intentions to cheat (Ajzen, 1991, 2001, 2002; Beck & Ajzen, 1991; Stone, Jawahar, & Kisamore, 2010; Thomas, 2015), we reviewed the literature in search of a potential deterrence to AAD. The review suggests that none of the deterrences in the extant literature (Table 2) are suitable for reducing AAD (e.g., Bernardi, Baca, Landers, & Witek, 2008; Cluskey, Craig, & Raiborn, 2011; Hollis, 2018). The review also suggests that deterrence should be implemented with little effort (e.g., Sattler, Wiegel, & Floris, 2017). Thus, the second objective of this study was to design and test an original low-effort warning post (WP) in a learning management system that warns that a dishonest student would be reported to the Office of Student Conduct (Fig. 3). WP was the independent variable in an experiment with AAD as the dependent variable (Fig. 4). Controlling for gender, test difficulty, and test score, we found that WP significantly reduced AAD (Tables 5 and 6). This finding has several contributions, including insights into the psychology of how to deter AAD based on Ajzen's theory that students' perceived psychological costs of being exposed reduce their intentions to cheat (Ajzen, 1991, 2001, 2002; Beck & Ajzen, 1991; Stone et al., 2010; Thomas, 2015), and contributes to an original deterrence to AAD when none of the deterrences in the extant literature are suitable for deterring AAD (e.g., Bernardi et al., 2008; Cluskey et al., 2011; Hollis, 2018).

The remainder of this paper is organized as follows. Section IIprovides a literature review and develops the two hypotheses. Section IIIdescribes the method used to test the two hypotheses. Section IVreports and discusses the results. Section Vcovers the limitations, contributions, and concluding remarks.

## 2. Literature review and development of hypothesis 1

We define AAD generically as a student suddenly involves in any one of the following: (a) the submission of work that is not one's own (Thomas, 2017), (b) the giving or receiving of illegal aid from other persons or materials brought into offline or online classroom (Emerson & Smith, 2022; Kelly et al., 2022; King & Case, 2014; Sorgo et al., 2015), (c) the use of prior knowledge of the contents of the test or quiz without authorization (Burrus, McGoldrick, & Schuhmann, 2007; Minarcik & Bridges, 2015), (d) the deliberate use of someone else's original ideas or materials without acknowledging its source (Abdolmohammadi & Baker, 2007), (e) misrepresentation, e.g., providing a false excuse to gain an assignment extension or deferment of an exam (Hensley et al., 2013), and (f) academic

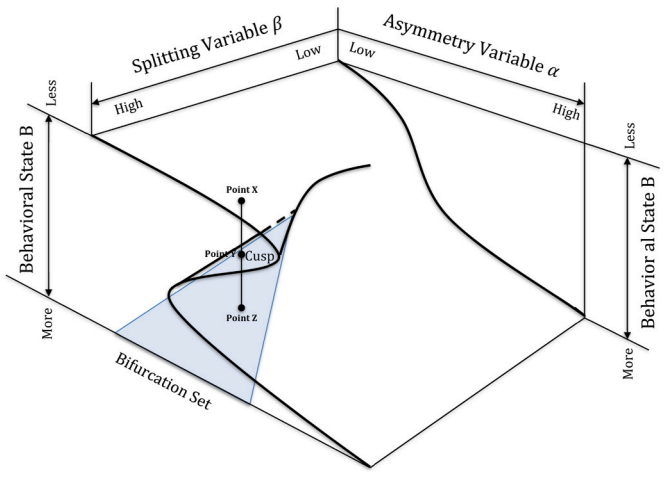



**Fig. 1.** The cusp catastrophe surface with the splitting variable $\beta$, the asymmetry variable $\alpha$, and the behavioral state B.

**Table 1**
Hypothesis 1: A summary of the literature review on the application of the cusp catastrophe model in the social sciences.

| Study | Discipline | Area of Research |
|---|---|---|
| Guastello, Correro, and Marra (2019)<br>Guastello et al. (2014) | Psychology | Model sudden changes in team performance produced by cognitive workload and fatigue associated with time pressure. |
| Diks and Wang (2016) | Business | Explain housing market crashes. |
| Yingluck (2016) | Business | Fit balance scorecard indices and the life cycles of organization growth. |
| Barunik and Kukacka (2015)<br>Barunik and Vosvrda (2009)<br>Zeeman (1974) | Business | Explain stock market crashes. |
| Hu and Xia (2015) | Information Sciences | Model sudden changes in a person's behavior, such as, an employee abruptly resigning from the job. |
| Sideridis and Stamovlasis (2014) | Education | Predict and explain academic cheating behaviors of elementary school students with learning disabilities |
| Sideridis, Antoniou, Stamovlasis, and Morgan (2013) | Education | Model disrupted reading performances of elementary and secondary students with learning disabilities. |
| Tao, Cao, Hu, and Dai (2013) | Geography | Describe a strong and abrupt change in landslide intensity in low-latitude highland areas. |
| Chow, Cheung, and Yiu (2012) | Information Sciences | Comprehend sudden withdrawal in construction project dispute negotiation |
| Stamovlasis and Tsaparlis (2012) | Education | Analyze unexpected changes in students' problem-solving behaviors in science education. |
| Ceja and Navarro (2012) | Business | Fit sudden and enjoyable merging of action and awareness - "into the zone" that represents a peak experience at work. |
| Wagner (2010)<br>Sheridan and Abelson (1983) | Nursing | Explicate job commitment and turnover of nursing employees |
| Smerz and Guastello (2008)<br>Clair (1998) | Education | Model binge drinking attitude and peer influence among college students. |
| Dou and Ghose (2006) | Business | Model online retail competition and sudden decline of less-established online retailers. |
| Cohen, Pargman, and Tenenbaum (2003)<br>Hardy (1996) | Psychology | Explore anxiety and abrupt drop in performance in sport. |
| Van der Maas et al. (2003) | Sociology | Test sudden changes in attitude as a function of involvement and information. |
| Lange, McDade, and Oliva (2001) | Business | Estimate abrupt adoptions of a high technology product (Lotus Freelance) when network externalities are present. |
| Sethi and King (1998) | Information Science | Study abrupt changes in user information satisfaction with various information systems components and attributes. |
| Haslett, Smyrnios, and Osborne (1998) | Psychology | Model rapid changes in anxiety levels from pre-arrival of university offers to post-arrival of offers. |
| Herbig (1991) | Business | Model sudden rejection or adoption of technological innovations. |
| Scapens, Ryan, and Fletcher (1981) | Business | Model sudden changes in corporate credit worthiness following the publication of accounting information in corporate failure. |
| Ho and Saunders (1980) | Business. | Examine bank failure when the path towards failure involves a sudden crash or catastrophe. |
| Tesser (1980) | Sociology | Model outburst of social conflicts when personal dispositional variables are in conflict with social pressure. |
| Holt, Brian, and Markus (1978) | Psychology | Interpret sudden eruption of international violence, such as, wars that start and escalate suddenly. |

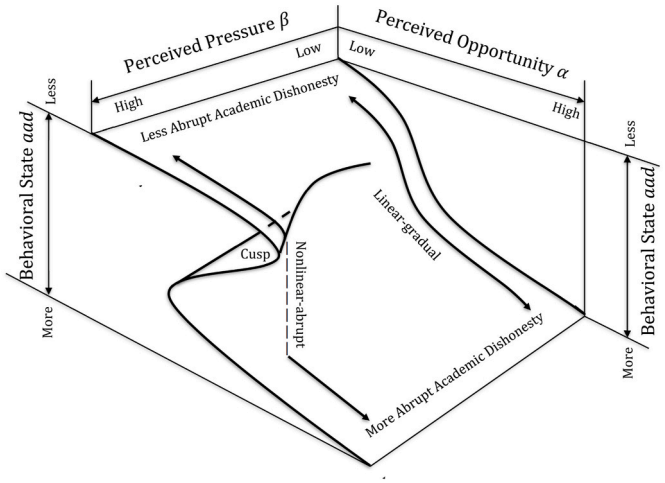



**Fig. 2.** Hypothesis 1: The Cusp Catastrophe Model with Perceived Pressure as the Splitting Variable ***β***, Perceived Opportunity as the Asymmetry Variable ***α***, and
Abrupt Academic Dishonesty as the Behavioral State ***aad***.

**Table 2**
Hypothesis 2: A summary of the literature review on deterrences to cheating in classrooms.

| Deterrences to Cheating | Study |
|---|---|
| 1. Use remote 3rd party proctoring services. | Grajek, 4/10/2020; Bedford et al., 2011. |
| 2. Underscore intrinsic learning goals. | Dyer 2020. |
| 3. Use on-line proctoring software. | Alessio et al., 2018; D'Souza & Siegfeldt, 2017. |
| 4. Enforce perceived and actual punishments. | Martinelli et al., 2018; Ogilvie & Stewart, 2010. |
| 5. Provide pre-reported average scores. | Isakov & Tripathy, 2017. |
| 6. Emphasize mastery of learning, such as, formative low stakes assessment. De-emphasize achievement and performance goals, such as, summative high stakes assessment.[a] | Anderman & Koenka, 2017; Tas & Tekkaya, 2010. |
| 7. Build institutional culture of integrity. | Boyle et al., 2016; Stephens, 2016. |
| 8. Cultivate whistleblower culture to dishonesty. | Bernardi, Landry, Landry, Buonafede, & Bardi, 2016; MacGregor & Stuebs, 2014; Jones, Spraakman, & Sánchez-Rodriguez, 2014. |
| 9. Instill fear for unethical conduct. | Mastracchio, N, Jiménez-Angueira, & Toth, 2015; Vance & Jimenez-Angueira, 2014. |
| 10. Enforce the honor code. | Pauli, Arthur, & Pice, 2014; O'Neill & Pfeiffer, 2012. |
| 11. Teach moral identity and academic honesty. | Gu & Neesham, 2014. |
| 12. Watch for red flags on cheating.[b] | Chen, Tang, & Tang, 2014; Pulvers & Diekhoff, 1999. |
| 13. Implement honor codes. | Bing et al., 2012; McCabe & Trevino, 1993. |
| 14. Increase the severity of punishments. | Molnar & Kletke, 2012; Brimble & Stevenson-Clarke, 2005. |
| 15. Set appropriate ethical tone at the top (school deans). | Brown, Weible, & Olmosk, 2010. |
| 16. Heighten faculty skepticism for managing cheating in the classroom. | Simon et al., 2003; 2004. |

[a] For example, Macdonald and Carroll (2006) suggest a holistic approach involving shared responsibility and low stakes formative assessments to reduce cheating.

[b] For example, Pulvers and Diekhoff (1999) suggest watching for red flags on collective cheating in the classroom environment.

**Table 3**
Hypothesis 1: Results of the coefficients.

| | Estimate | Std. Error | $z$ value | P (>\| $z$ \|) |
|---|---|---|---|---|
| $\alpha$ [Intercept] | 0.16308 | 0.61842 | 0.298 | 0.8032 |
| $\alpha$ [Opportunity]* | 0.50632 | 0.12967 | 8.012 | <0.0001 |
| $\alpha$ [Pressure] | 0.07896 | 0.06779 | 1.692 | 0.0841 |
| $\beta$ [Intercept] | 0.16539 | 0.45972 | 0.433 | 0.7935 |
| $\beta$ [Pressure]* | 0.36154 | 0,04123 | 8.676 | <0.0001 |
| $\gamma$ [Intercept] | 0.20618 | 0.37881 | 0.576 | 0.7335 |
| $\gamma$ [Cheating]* | 0.86634 | 0.07853 | 15.834 | <0.0001 |

*$p < 0.01$.

**Table 4**
Hypothesis 1: Model fit statistics.

| | $R^2$ | AIC | AICc | BIC |
|---|---|---|---|---|
| Linear model | 0.1730 | 4877.3 | 4877.3 | 4311.3 |
| Logist model | 0.2003 | 4822.1 | 4822.1 | 4876.4 |
| Cusp model | 0.0988 | 4037.6 | 4037.6 | 4076.8 |

AIC = Akaike Information Criterion.
AICc = Correction to the AIC for small sample size.
BIC = Bayesian Information Criterion.

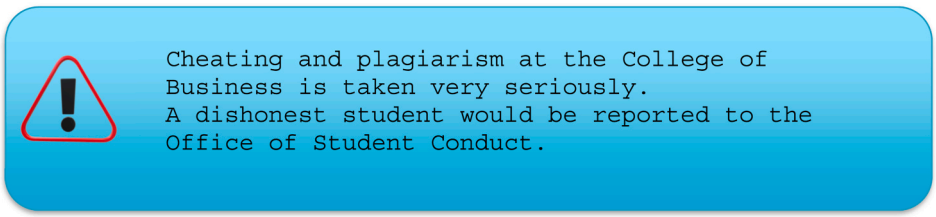



**Fig. 3.** Hypothesis 2 materials and procedures: A low-effort warning post (WP) in learning management systems.



**Fig. 4.** Hypothesis 2 materials and procedures: A make-believe paper shredder attached to a non-see-through office thrash container.

**Table 5**
Hypothesis 2: Descriptive statistics, pearson correlations, and logistic regression analyses.

Panel A: Descriptive Statistics

| Variable | Mean | 25th Percentile | Median | 75th Percentile | Std. Dev. |
|---|---|---|---|---|---|
| Abrupt Academic Dishonesty AAD | 0.03 | 0.00 | 0.00 | 0.00 | 0.181 |
| Warning Post WP | 0.52 | 0.00 | 1.00 | 1.00 | 0.500 |
| Gender G | 0.48 | 0.00 | 0.00 | 1.00 | 0.500 |
| Test Difficulty TD | 2.20 | 2.00 | 2.00 | 3.00 | 0.749 |
| Test Score TS | 6.05 | 4.00 | 6.00 | 8.00 | 2.659 |

Panel B: Pearson Correlations

| | AAD | WP | G | TD | TS |
|---|---|---|---|---|---|
| 1. Abrupt Academic Dishonesty AAD | | | | | |
| 2. Warning Post WP | −.122*** | | | | |
| 3. Gender G | .051 | −.096** | | | |
| 4. Test Difficulty TD | .188*** | .000 | .000 | | |
| 5. Test Score TS | −.211*** | .039 | .001 | .000 | |

Panel C: Logistic Regressions

| | | Abrupt Academic Dishonesty AAD (H2) |
|---|---|---|
| Independent Variable | Predicted Sign | Est. Coefficient (z-statistic) |
| Warning Post WP | − | −0.111** (-2.859) |
| Gender G | ? | 0.040 (1.041) |
| Test Difficulty TD | + | 0.171*** (4.436) |
| Test Score TS | − | −0.192*** (-4.966) |
| Intercept | +/− | 0.035 |
| Pseudo $R^2$ | | 0.082 |
| −2 Log Likelihood | | 115.16 |
| Logistic Regression Chi-Square Statistic | | 68.30*** |
| Percentage Correctly Classified | | 96.6% |
| Observations | | 620 |

*, **, *** indicates $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively, based on one-tailed tests for directional expectations.Numbers in parentheses are test statistics based on robust standard errors.

**Table 6**
Hypothesis 2: Additional logistic regression analyses.

| | | Abrupt Academic Dishonesty |
|---|---|---|
| | | AAD (H2) |
| | Predicted | Est. Coefficient |
| Independent Variable | Sign | (z-statistic) |
| Warning Post WP | – | −0.102** |
| | | (-2.341) |
| Gender G | ? | 0.026 |
| | | (1.013) |
| Test Difficulty TD | + | 0.166*** |
| | | (4.160) |
| Test Score TS | – | −0.175*** |
| | | (-4.739) |
| Age A | ? | 0.186 |
| | | (2.006) |
| Undergraduate/Graduate UG | ? | 0.017 |
| | | (0.732) |
| Part-time/Full-time PF | ? | 0.003 |
| | | (-0.011) |
| Course Load CL | ? | 0.091 |
| | | (1.767) |
| Intercept | +/− | 0.029 |
| Pseudo R2 | | 0.076 |
| −2 Log Likelihood | | 113.02 |
| Logistic Regression Chi-Square Statistic | | 71.23*** |
| Percentage Correctly Classified | | 94.1% |
| Observations | | 620 |

*, **, *** indicates $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively, based on one-tailed tests for directional expectations.
Numbers in parentheses are test statistics based on robust standard errors.

sabotage, e.g., hiding or destroying books in a library so that other students cannot use them (Whitley & Keith-Spiegel, 2002).

The Fraud Triangle is the underpinning of many prior studies on student cheating behaviors (e.g., Smith et al., 2022; Homer, 2020; Burke & Sanney, 2018; Becker et al., 2006). It consists of three elements: rationalization, perceived opportunity, and perceived pressure (Dorminey et al., 2012; Albrecht et al., 2019). Rationalization refers to a student's justification for cheating (e.g., Shepherd & Button, 2019); perceived opportunity refers to circumstances that allow cheating to occur (e.g., Becker et al., 2006) and perceived pressure refers to non-shareable financial problems that create the motive for cheating (e.g., Choo & Tan, 2008). Perceived pressure and opportunity are two elements of the Fraud Triangle that may influence AAD (Homer, 2020). For example, perceived pressure from parents or graduate schools to make good grades (Becker et al., 2006; Daumiller & Janke, 2020) and perceived opportunities to purchase exam questions and answers online (Emerson & Smith, 2022; Peterson, 2004) may induce AAD. We reviewed the literature (Table 1) but found no study relating the two elements to AAD formulated on a cusp catastrophe model. Thus, we develop a relationship (Fig. 2) between the two elements, namely, perceived pressure (splitting variable $\beta$) and perceived opportunity (asymmetry variable $\alpha$), and AAD (the behavioral state) formulated on the cusp catastrophe model (Arnold, 2004, pp. 3–6; Poston & Stewart, 1996, pp. 174–176; Zeeman, 1976) as follows.

### *2.1. Defining abrupt academic dishonesty AAD as the behavioral state (**aad**))*

A cusp catastrophe model (Arnold, 2004, pp. 3–6; Poston & Stewart, 1996, pp. 174–176; Zeeman, 1976) describes how changes in a dependent variable, "behavioral state," are related to the levels of two independent variables, known as the "splitting variable $\beta$" and "asymmetry variable $\alpha$" as depicted in Fig. 1 (Gilmore, 1993, pp. 94–105; Woodcock & Davis, 1980, pp. 31–58; Zeeman, 1976). The model is capable of handling complex linear and nonlinear relationships simultaneously using a high order probability density function that has the advantage of being able to incorporate an abrupt transition from less to more of a behavioral state (Cobb, 1981; Cobb & Watson, 1980).

As Fig. 1 shows, at low levels of splitting variable $\beta$, a linear-gradual transition of behavioral state B from less to more behavioral state B is analogous to a linear-gradual transition from less to more abrupt academic dishonesty (AAD), whereas at high levels of splitting variable $\beta$, a nonlinear-abrupt transition of behavioral state B in the cusp area is analogous to a nonlinear-abrupt AAD (Isnard & Zeeman, 2019, pp. 3–19; Stewart & Peregoy, 1983). For the cusp catastrophe model to be useful in understanding the differences between these linear-gradual and nonlinear-abrupt AAD (Castrigiano & Hayes, 2018, pp. 35–57), it is necessary to operationally define the splitting variable $\beta$, the asymmetry variable $\alpha$, and the AAD as the behavioral state *aad* as shown in Fig. 2.

As Fig. 2 depicts, the dependent behavioral state of interest at one end, indicated at the top of the vertical dimension by less *aad*, is less abrupt academic dishonesty (AAD). On the other end, indicated at the bottom by more *aad*, there is more AAD. The term behavioral state, as used here, reflects the common usage of that term to indicate the dependent variable; it is not used to imply actual overt behavioral inclination (Isnard & Zeeman, 2019, pp. 3–12; Flay, 1978). At the back edge of the behavioral surface plane, the

transition from less *aad* to more *aad* is continuous and linear-gradual from less AAD at the top to more AAD at the bottom. However, at the front edge of the surface, the transition is discontinuous and nonlinear-abrupt from the lower AAD, at the top, to more AAD, at the bottom (Isnard & Zeeman, 2019, pp. 3–19; Stewart & Peregoy, 1983). Finally, less AAD is assumed to be incompatible with more AAD, such that the two cannot reasonably exist simultaneously (Stewart & Peregoy, 1983).

### 2.2. Influence of perceived opportunity on abrupt academic dishonesty AAD

As Fig. 2 depicts, the perceived opportunity to cheat, the asymmetry variable $\alpha$, comprises all the perceived opportunities disposing students of less abrupt academic dishonesty (AAD), the behavioral state *αad*, and conversely, all the same opportunities disposing them of more AAD. In accounting education, Dorminey et al. (2012, p. 558) state, "[p]erceived opportunity is the perception (1) that a control weakness is present, and importantly, (2) that the likelihood of being caught is remote. Therefore, perceived opportunity requires the ability to commit the act, and to do so without detection." These perceived opportunities to cheat include, but are not limited to, faculty's lack of deterrence (Birks, Smithson, Antney, Zhao, & Burkot, 2018), ghost students, e.g., paying someone to take online class (Hollis, 2018), take-home versus in-class assignments and exams (Lonsdale, 2017), peer-to-peer file sharing on internet (Rogerson, 2016), a lack of online (Berkey & Halfond, 2015) or offline (Kerkvliet & Sigmund, 1999; Sorgo et al., 2015) class proctors, exam questions and answers can be purchased online (Berkey & Halfond, 2015; Emerson & Smith, 2022; Gismondi, 2006; Kelly et al., 2022), hacking lockdown browsers (Cluskey et al., 2011), copying and pasting from the Internet (Becker et al., 2006), ability to hide test answers in electronic devices (Baek & Choi, 2002), assignments can be plagiarized (Olt, 2002), faculty's low surveillance conditions (Covey, Saladin, & Killen, 2001), seats can be arranged to look at others' answers (Houston, 1983a, 1983b), and so on. In describing the change from less to more AAD, the magnitude of perceived opportunity is increased by opportunities disposing students to more AAD and decreased by opportunities disposing them to less AAD. Thus, the more perceived opportunities there are, the more AAD is on the right dimension of the behavioral surface plane, and vice versa.

Our literature review suggests that AAD vary with the perception of the opportunity to cheat. For example, Sorgo et al. (2015) found that the perceived opportunity to cheat is "a way of life in Slovenian schools, and almost all students at least occasionally indulge in some academic misbehaviour." Fask, Englander, and Wang (2014) found evidence that students taking an online unproctored test had higher levels of perceived opportunities to cheat than those taking the same test on a proctored face-to-face test. King, Guyette, and Piotrowski (2009) found that 73% of their students reported more opportunities to cheat online than in face-to-face classes. Watson and Sottile (2010) reported that when asked if they were likely to cheat, their students indicated that they were more than four times more likely to cheat in an online class than in a face-to-face class. Hugh and McCabe (2006) and Bolin (2004) found that students generally cheated more when they perceived a higher opportunity to do so. Becker et al. (2006) found that business students' perceived opportunity to cheat gives rise to an overall propensity of 23.2%. Smith, Davy, Rosenberg, and Haight (2002) found that perceived opportunity to cheat is related to students' future cheating behavior. Lastly, Mohammed, Rawwas, and Isakson (2000) reported that the perception of high in-class opportunities to cheat explains most students' cheating in the classroom.

### 2.3. Influence of perceived pressure on abrupt academic dishonesty AAD

As Fig. 2 depicts, perceived pressure to cheat, the splitting variable $\beta$, comprises all the perceived pressures disposing students of less abrupt academic dishonesty (AAD), the behavioral state *αad*, and conversely, all the same pressures disposing them of more AAD. In accounting education, Dorminey et al. (2012, p. 558) state, "[p]erceived pressure from a non-shareable financial problem creates the motive for the crime. An individual may deem an issue non-sharable due to his/her perception of the social stigma associated with owning such a problem. Additionally, a strong sense of ego or pride may prevent an individual from seeking help or sharing the problem." Our review of prior literature indicates that these perceived pressures to cheat include, but are not limited to, social norm (Bernardi & Higgins, 2020; Conway, Hard, & Moran, 2006; O'Rourke et al., 2010), achieve high performance in tests (Daumiller & Janke, 2020), group loyalty in collective cheatings (Hildreth, Gino, & Bazerman, 2016; Pulfrey, Durussel, & Butera, 2018), competitive majors (D'Souza & Siegfeldt, 2017), in-class competition (Miller, Murdock, Anderman, & Grotewiel, 2017; Perry, Kane, Bernesser, & Spicker, 1990), learning disabilities (Sideridis & Stamovlasis, 2014), lack good time management (Abdolmohammadi & Baker, 2007; Guo, 2011),[1] summative high-stakes tests (Boyle, Boyle, & Carpenter, 2016; Stephens & Gehlbach, 2007), student loan or other financial obligations (Callahan, 2007), make good grades (Becker et al., 2006; Taylor, Pogrebin, & Dodge, 2002), social pressure from classmates (Bolin, 2004; McCabe, Butterfield, & Trevino, 2006), stressful exam and homework situations (Passow, Mayhew, Finelli, Harding, & Carpenter, 2006), social acceptance by classmates (Iyer & Eastman, 2008; McCabe, Trevino, & Butterfield, 2000), losing a scholarship or being placed on probation (Sheard, Markham, & Dick, 2003), future job prospects or pursue internships (Brown, 2002), graduate on time (Davis, Grover, Becker, & McGregor, 1992), and so on. The magnitude of perceived pressure determines whether transitions in AAD will be continuous (a unimodal distribution of possible locations) or discontinuous (a bimodal distribution of split locations) (Cobb, 1981; Cobb & Watson, 1980). If perceived pressure is low, as perceived opportunity increases from low to high, the transitions in AAD will be continuous and linearly gradual from less to more AAD. However, if perceived pressure is high, as perceived opportunity increases from low to high, the transitions in AAD cease to be continuous at the fold and abruptly jump from less AAD at the top of the behavioral surface plane to more AAD at the bottom of the behavioral surface plane (Flay, 1978; Van der Maas, Kolstein,

[1] In accounting education, point of time during the semester has been used as a surrogate for the effect of pressure on cheating in the classroom (Abdolmohammadi & Baker, 2007).

& van der Pligt J, 2003).

Prior research suggests that perceived high pressure to cheat is a dominant condition in abrupt academic dishonesty (AAD). For example, Boyle et al. (2016) found that the perceived pressure to obtain high grades is related to cheating at private and AACSB-accredited institutions. Anderman, Cupp, and Lane (2009) found that impulsivity, the tendency to intuitively decide under perceived high time pressure, is correlated with cheating in the classroom. Ng, Davis, Bates, and Avellon (2003) found that high perceived peer pressure for social acceptance is the main reason for cheating. Burton and Near (1995) found that perceived high pressure for better grades dominated the incidence of cheating in the classroom. Perry et al. (1990) reported that the high perceived pressure to compete with peers is a key condition for cheating among Type A students. Finally, Lane and Schaupp (1989) found that high perceived pressure to complete a degree in time was related to cheating in the classroom.

If the cusp catastrophe model for perceived pressure to cheat, the splitting variable $\beta$, and perceived opportunity to cheat, the asymmetry variable $\alpha$, is valid, the model's effect on AAD, known as a "hysteresis" effect, is predictable by levels of perceived pressure (Isnard & Zeeman, 2019, pp. 3–19; Stewart & Peregoy, 1983). At low levels of perceived pressure, on the right back portion of the behavioral surface plane, away from the cusp area (see Figs. 1 and 2), the hysteresis effect predicts that the AAD will stay on that surface plane until the level of perceived pressure is high enough to move it to the cusp area. At high levels of perceived pressure, on the left front portion of the behavioral surface plane in the cusp area, where the vertical line intersects both the upper and lower surfaces, the hysteresis effect predicts that the AAD will remain in the cusp area until there is no more cusp surface plane, at which point it makes a radical abrupt transition to the other surface plane (Cobb, 1981; Cobb & Zacks, 1985). Anecdotal evidence of this abrupt transition has been reported in literature. For example, Kobis, Verschuere, Bereby-Meyer, Rand, and Shalvi (2019) and Christian and Ellis (2011) observed that when people are tired under time pressure, they are more prone to abrupt self-serving dishonesty. Cohn and Marechal (2017) have observed abrupt cheating in schools. Dai, Galeotti, and Villeval (2017) observed some abrupt fare dodging in public transportation. Hodgkinson, Curtis, MacAlister, and Farrell (2016) and Bunn, Caudill, and Gropper (1992) observed abrupt "panic-cheating" among undergraduate students. Gino (2015) observed an abrupt fudging of tax payments by people. Bamber, Ramsay, and Tubbs (1997), Glover (1997), and McMillan and White (1993) observed that when researchers' perceived pressures to accept an alternative hypothesis are low, their transitions to reject a null hypothesis are gradual. However, when researchers' perceived pressures to accept an alternative hypothesis are high, their transition to reject the null hypothesis is abrupt. Choo and Firth (2003) observed that auditors abruptly disengaged in processing complex audit evidence, also known as "configural cue processing," if they did not have sufficient time to retrieve configural patterns of audit evidence from their working memory. Raghunathan (1991) observed auditors unexpectedly signing off their audit work under high deadline pressure. Kelley and Margheim (1990) observed that auditors abruptly under-report their work time budgets when they are under high time pressure to complete certain tasks. Additionally, Jones, Massey, and Thorne's (2003) accounting literature reviews on ethical reasoning suggest that auditors under clients' intense pressure might abruptly misrepresent their audit works/reports. Finally, anecdotal evidence of an abrupt transition is posted on social media. For example, Elliot Castro (Forsyth & Castro, 2008), a credit card ex-fraudster, and Richard Bitner (Bitner, 2008), a subprime lender ex-fraudster, posted their confessions on social media that they initially had no intention of fraud, but under mounting pressure to fraud, at a certain point, they committed fraud suddenly.

In summary, empirical and anecdotal evidence suggests that the perceived pressure and perceived opportunity of the Fraud Triangle influence the AAD nonlinearly formulated on the cusp catastrophe model such that.

**H1**. Students are involved in abrupt academic dishonesty (AAD) at high (low) levels of perceived pressure (opportunity) to cheat.

## 3. Literature review and development of hypothesis 2

Given that students might be involved in abrupt academic dishonesty (AAD), we reviewed the literature in search of potential deterrence for AAD. Table 2 summarizes our literature review on deterrences to cheating in the classrooms. This review suggests that none of the existing deterrences is suitable for deterring AAD. For examples, using remote 3rd party proctoring services (Grajek, 4/10/2020; Bedford, Gregg, & Clinton, 2011) may lead to poorer test performance due to stereotype threats coupled with traumatic histories of surveillance (Woldeab & Brothen, 2019). Using online proctoring software (Alessio, Malay, Maurer, John Bailer, & Rubin, 2018; D'Souza & Siegfeldt, 2017) may make students computers more vulnerable to malware (Chin, 2020). Enforcing perceived and actual punishment (Martinelli, Parker, Perez-Gea, & Rodrigo, 2018; Ogilvie & Stewart, 2010) may not necessarily reduce cheating in the classroom (Ullah, 2019; Walters & Morgan, 2018). Instilling the fear of unethical conduct (Mastracchio, Jiménez-Angueira, and Toth 2015; Vance & Jimenez-Angueira, 2014) only deters a small number of students from cheating (Bartlett, 2003; Bay & Greenberg, 2001; Bernardi et al., 2004; West, Ravenscroft, & Shrader, 2004). Implementing honor codes (Bing et al., 2012; McCabe & Trevino, 1993) has limited success in deterring cheating; for example, students may pledge to the honor codes, but shamefully untruthful (Houston, 1983a, 1983b). Lastly, increasing the severity of punishment for cheating does not deter academic dishonesty (Frelburger, Romain, Randol, & Marcum, 2016; Walters and Morgan 2018) nor does it affect students' perceptions of cheating (Molnar & Kletke, 2012; Sitren & Applegate, 2007). Thus, given that none of the existing deterrences are suitable for deterring AAD, we decided to design

and test an original deterrence to AAD.

### 3.1. Designing and testing an original low-effort warning post (WP)

Ajzen's theory suggests that students' intentions to cheat depend on their perceived psychological costs of being exposed (Ajzen, 1991, 2001,2002; Beck & Ajzen, 1991; Stone et al., 2010).[2] For example, Stone et al. (2010) studied the cheating intentions of 241 business undergraduates. They found that 36% of students' intentions to cheat depended on their perceived psychological costs of being exposed. These perceived psychological costs of being exposed include, but are not limited to, anticipating the effect of shame and embarrassment of involvement (Cochran, Chamlin, Wood, & Sellers, 1999; Hodgkinson et al., 2016), anticipating the negative psychological effect of guilt (Kobis, van Prooijen, Righetti, & van Lange, 2016; Peer, Acquisti, & Shalvi, 2014; Batigalli, Dufwenberg, & Charness, 2013), feeling the negative emotion effect of confessions (Minarcik & Bridges, 2015), experiencing the psychological discomfort - the "psychic cost" of dishonest acts (Thomas, 2015), dreading others will see oneself as a "bad person" doing something unethical or morally wrong (Abdolmohammadi & Baker, 2007; Murdock, Hale, & Weber, 2001; Reisenwitz, 2012), reliving the negative emotional effect of previous dishonest experiences (Houser, Vetter, & Winter, 2012), perceiving the psychological costs of social stigma from violating self-image norms (Eisenhauer, 2008; Grasmick & Scott, 1982), and seeing oneself being a social outcast as a consequence (Anderman, 2003; Finn & Frone, 2004). Prior studies have also found that the perceived psychological costs of being exposed reduce students' intention to cheat. For example, Maruna and Copes (2005) found that the perceived psychological costs of exposure significantly reduced the frequency of cheating in the classroom. Grolleau, Kocher, and Sutan (2016) found that fear of perceived psychological costs, rather than lure of perceived psychological gains reduced cheating. Thomas (2015) found the level of psychological discomfort experienced, i.e., the "psychic cost" of tax evasion, reduced cheating in tax reporting. Adams and Mullen (2012) found that the perceived psychological costs of depleted ego and social status reduce dishonest acts. Based on Ajzen's theory that students' perceived psychological costs of being exposed reduce their intentions to cheat (Ajzen, 1991, 2001, 2002; Beck & Ajzen, 1991; Stone et al., 2010; Thomas, 2015), we designed an original warning post (WP) in learning management systems that warns a dishonest student would be reported to the Office of Student Conduct (Fig. 3).

Prior studies also suggest designing a WP for implementation with little effort (i.e., to design a low-effort WP). For example, Sattler et al. (2017) found that when the effort to implement deterrence is low, the frequency of faculty members applying that deterrence increases. Coren (2011) found that faculty members frequently cite high time consumption in implementing deterrence as one of the major reasons they do not take deterring action against cheating in the classroom. Keith-Spiegel, Tabachnick, Whitley, and Washburn (1998) found that the main reason faculty often ignore cheating is the perceived high opportunity costs involved in dealing with it. Finally, Savage (2004) found that faculty members do not take action against plagiarism because they perceive the effort of applying text-matching software to reduce plagiarism to be time-consuming, especially for large classes.

In summary, based on Ajzen's theory that students' perceived psychological costs of being exposed reduce their intentions to cheat (Ajzen, 1991, 2001, 2002; Beck & Ajzen, 1991; Stone et al., 2010; Thomas, 2015) and prior studies' suggestions on designing a deterrence for implementation with little effort (e.g., Sattler et al., 2017), we designed a low-effort warning post (WP) that warns a dishonest student would be reported to the Office of Student Conduct (see Fig. 3) and tested whether it would reduce AAD as follows.

**H2.** A low-effort warning post (WP) in learning management systems that warns a dishonest student would be reported to the Office of Student Conduct would reduce abrupt academic dishonesty (AAD).

## 4. Methods

### 4.1. H1: applying the cusp catastrophe model

The cusp catastrophe model was originally developed to better understand nonlinear transitions in physical sciences (Gilmore, 1993, pp. 94–105; Woodcock & Davis, 1980, pp. 31–58; Zeeman, 1976). Thus, the term catastrophe has little to do with the importance, magnitude, or devastating consequences of an event, as is often implied in non-mathematical uses of the term (Arnold, 2004, pp. 3–6). Mathematically, all that is meant by a catastrophe is a nonlinear transition from one state to another (Deakin, 1980). For example, consider the application of pressure to an air balloon. As the pressure increased, nothing was observed and the balloon remained intact. However, at some point, a minuscule increase in pressure caused the balloon to pop. The transition from intact to pop is a catastrophe (Kusmartsev, 1989). In other words, it is a change of state from intact to pop, which does not occur as a linear gradual change induced by gradual increases in pressure but as a radical transformation of state, a catastrophe. In this sense, many disasters can be catastrophic (Guastello, 2013, pp. 4–11). For example, an avalanche is a physical transition of a state induced by the accumulated weight of a new snow. A dam may burst abruptly owing to an increase in floodwater.

In mathematics, the cusp catastrophe model describes how changes in a dependent variable, "behavioral state," are related to the levels of two independent variables, known as the "splitting variable $\beta$" and "asymmetry variable $\alpha$" as depicted in Fig. 1 (Gilmore,

[2] Ajzen's theory on students' intentions to cheat and perceived psychological costs has been tested and supported in various academic disciplines, for example, social sciences (Alleye & Phillips, 2011), business (Chapman & Lupton, 2004; Stone et al., 2010), engineering (Harding, Mayhew, Finelli, & Carpenter, 2007), and in various academic majors, for example, accounting (Emeen, Guffey, & McMillan, 1996; Tepper & Yourstone, 2018), marketing (Chapman, Davis, Toy, & Wright, 2004), and criminal justice (Lambert & Hogan, 2004).

1993, pp. 94–105; Woodcock & Davis, 1980, pp. 31–58; Zeeman, 1976). The model is capable of handling complex linear and nonlinear relationships simultaneously using a high order probability density function that has the advantage of being able to incorporate an abrupt transition from less to more of a behavioral state (Cobb, 1981; Cobb & Watson, 1980).

The cusp catastrophe model for a behavioral state is

$$\frac{\partial y}{\partial t} = -\frac{\partial V(y;c)}{\partial y}, y \in R^k, c \in R^p \ . \tag{1}$$

In this equation, $y(t)$ represents the behavioral state variable(s) and $c$ represents one or multiple (control) parameter(s) that determine the specific structure of the behavioral state (Isnard & Zeeman, 2019, pp. 21–35). If behavioral state $y$ is at a point where $\partial V(y;c)/dx = 0$, then the behavioral state is in equilibrium. If the behavioral state is at a non-equilibrium point, it moves towards an equilibrium point, where the function $V(y; c)$ acquires a minimum with respect to $y$ (Kusmartsev, 1989). These equilibrium points are stable because the behavioral state returns to this point after a small perturbation to the behavioral state. Equilibrium points that correspond to the maxima of $V(y; c)$ are unstable equilibrium points because a perturbation to the behavioral state causes it to move away from the equilibrium point towards a stable equilibrium point (Cobb, 1981). Equilibrium points that correspond neither to maxima nor to minima of $V(y; c)$, at which the Hessian matrix $(\partial^2 V(y)/\partial y_i \partial y_j)$ has eigenvalues equal to zero, are called degenerate equilibrium points, which are the points at which a behavioral state can give rise to unexpected "bifurcations" in its equilibrium states when the splitting and asymmetry variables of the behavioral state are changed (Chen & Chen, 2015). Degenerate equilibrium points are characterized by a set of seven canonical forms or "universal unfoldings" (Poston & Stewart, 1996, pp. 123–170; Gilmore, 1993, pp. 94–105). These universal unfoldings are called the "elementary catastrophes," which constitute different types of catastrophe models (Castrigiano & Hayes, 2018, pp. 35–57).

Among the various types of catastrophe models, the cusp catastrophe model has been most useful for describing nonlinear relationships in the social sciences (Flay, 1978; Van der Maas et al., 2003). We summarize our literature review on the application of the cusp catastrophe model in the social sciences in Table 1.

The canonical form of the cusp catastrophe model is

$$-V(y;\ \alpha,\beta) = \alpha y + \frac{1}{2}\beta y^2 - \frac{1}{4}y^4 \ . \tag{2}$$

Its equilibrium points, as a function of the control parameters $\alpha$ and $\beta$, are solutions to the following equation:

$$\alpha + \beta y - y^3 = 0 \ . \tag{3}$$

This equation has one solution if $\delta = 27\alpha - 4\beta^3$, which is known as "cardan's discriminant," is greater than zero, and has three solutions if $\delta < 0$ (Cobb, Koppstein, & Chen, 1983). These solutions are depicted in Fig. 1 as a two-dimensional behavioral surface in a three-dimensional space, the floor of which is the two-dimensional $(\alpha, \beta)$ canonical coordinates called the "control plane" (Isnard & Zeeman, 2019, pp. 12–43). The set of values of $\alpha$ and $\beta$ for which $\delta = 0$ demarcates the "bifurcation set," which is the shaded cusp-shaped area on the floor in Fig. 1. The $\alpha$ coordinate is called the "asymmetry" variable, while the $\beta$ coordinate is called the "splitting" variable (Stewart & Peregoy, 1983). The bifurcation set is determined by the asymmetry α variable and splitting $\beta$ variable. The former changes the behavioral surface plane asymmetrically as it increases, whereas the latter suddenly changes the behavioral surface plane as it increases (Grasman, van der Maas, & Wagenmakers, 2009).

The folded shape depicted in Fig. 1 is called the "behavioral surface" (Cobb, 1981; Cobb & Watson, 1980). The only stable locations for behavioral state B are assumed to be on this surface. If we assume a horizontal plane, defined by the two independent variables, that plane is referred to as the "behavioral surface plane" (Downing, 2005). At most points on that plane, defined by the levels of the two independent variables, a vertical line projected perpendicular to the plane will intersect with the behavioral surface plane at one and only one point on the vertical behavioral state B, between the less behavioral state B at the top and the more behavioral state B at the bottom (Cobb, 1981). This indicates the level of behavioral state B that will occur for the levels of the two independent variables. The vertical line encounters the fold in the behavioral surface plane; however, it intersects the surface at three points, X, Y, and Z, one of which is on the underside of the fold. A projection onto the horizontal behavioral surface plane of all possible three-point locations will define a "cusp" shaped area, wide at the front edge of the space, and receding to a sharp point somewhere prior to reaching the back edge (Cobb, 1981; Cobb & Watson, 1980). It is assumed that a behavioral state is not possible on the underside of the fold (point Y in the cusp area), which means that a vertical projection inside the cusp area will only intersect the behavioral surface plane at two points, X and Z, and that a behavioral state cannot be at two points simultaneously (Cobb, 1981; Cobb & Watson, 1980).

The cusp catastrophe model describes the nonlinear dynamics of the transition between points X and Z in a cusp area (Poston & Stewart, 1996, pp. 174–176). If the level of the asymmetry variable $\alpha$ is low and the level of the splitting variable $\beta$ is high, the intersection with the behavioral surface is to the left on the top surface near the front edge. As increases in the asymmetry variable $\alpha$ forces move the point to the right, it enters the area of the fold and cusp (Gilmore, 1993, pp. 94–105). When the cusp is encountered, behavioral state B persists on the top surface until it reaches the far-right side of the cusp, at which point the top surface ceases to exist. Behavioral state B undergoes a radical transition to the lower surface (Stewart, 1981). However, if behavioral state B starts on the lower surface and moves into the cusp area from the right, it will persist on the bottom surface until the far-left edge of the cusp and the surface no longer exists. At this point, behavioral state B jumps to the top surface (Flay, 1978). Finally, if the level of the splitting variable $\beta$ is low, increases in the asymmetry variable $\alpha$ move the intersection point along the back edge of the behavioral surface plane from left to right. In so doing, the position of the surface on behavioral state B will gradually transition from a less behavioral state at

the top to a more behavioral state at the bottom, that is, a linear transition with no discontinuities (Stewart & Peregoy, 1983).

### 4.2. H1: Materials and Procedures

For Hypothesis 1, there are two approaches to fit the CUSP model to student-cheating data. The first approach is to verify the presence of specific behavioral characteristics that support an abrupt behavioral state (Gilmore, 1993; Stewart & Peregoy, 1983; Van der Maas et al., 2003; Van der Maas & Molenaar, 1992). For example, Gilmore (1993, pp. 157–182) uses specific behavioral characteristics, called "catastrophe flags," to verify the presence of these flags that support the abrupt behavioral state. One problem with this approach is that the cusp catastrophe model applies to deterministic physical characteristics in the physical sciences, as described in Equation (#1), which cannot be applied directly to stochastic behavioral characteristics that are subject to random influences in this social sciences study. The second approach uses Grasman et al.'s (2009) statistical Cusp R software to fit the cusp catastrophe model to the data (Cobb, 1981; Cobb & Ragade, 1978; Cobb & Watson, 1980; Cobb & Zacks, 1985). Cobb et al. (R Development Core Team, 2009) turn the catastrophe model into a stochastic catastrophe model by adding to Equation (#1) a white noise Wiener process, $dW(t)$, with variance $\sigma^2$, and treated the resulting equation as a stochastic differential equation (SDE):

$$dY = \frac{\partial V(Y;\ \alpha, \beta)}{\partial Y} dt + dW(t). \tag{4}$$

This SDE is then associated with a probability density that describes the distribution of the behavioral states at any moment in time, which is expressed as

$$f(y) = \frac{\psi}{\sigma^2} \exp\left[\frac{\alpha(y-\lambda) + \frac{1}{2}\beta(y-\lambda)^2 - \frac{1}{4}(y-\lambda)^4}{\sigma^2}\right]. \tag{5}$$

where $\psi$ is a normalizing constant and $\lambda$ determines the origin of the scale of the behavioral state. In this stochastic context, $\beta$ is the bifurcation factor, which determines the number of modes of the density function, and $\alpha$ is the asymmetry factor, which determines the direction of density skew. The density is symmetric if $\alpha = 0$ and becomes left- or right-skewed depending on the sign of $\alpha$ (Cobb, 1981). The function, $f(y)$, is executed by the most widely used software package, the Cusp R (Cobb et al., 1983; Cobb & Watson, 1980; Grasman et al., 2009). This software package is available for downloading from the Comprehensive R Archive Network (http://CRAN.R-project.org/package=cusp). The package contains several functions for use in catastrophe modeling, including utility functions to generate observations from the cusp density, evaluate the cusp density and cumulative distribution function, fit the cusp catastrophe, evaluate the model fit, and display the results.

We adopted the second approach and used Grasman et al.'s (2009) statistical Cusp R software to fit the cusp catastrophe model Equation (#5) (Cobb, 1981; Cobb & Ragade, 1978; Cobb & Watson, 1980; Cobb & Zacks, 1985) to the student cheating data provided by Choo and Tan (2008). We obtained their permission to fit the cusp catastrophe model to the data. Choo and Tan's (2008) data contain 182 accounting students' self-reported cheatings on a scale from 0 percent = never to 100 percent = absolutely, their perceived opportunity to cheat on a 10-point scale from 1 = low to 10 = high, and their perceived pressure to cheat on a 10-point scale from 1 = low to 10 = high. The student demographics were as follows: male (45.1%), female (54.9%), freshman (1.7%), sophomore (5.7%), junior (40.6%), senior (49.7%), graduate (2.3%), full time (90.1%), part time (9.9%), international students (0.3%), GPA less than 2.0 (1.1%), 2.0 and 2.59 (12.6%), 2.6 and 2.99 (25.7%), 3.0 and 3.59 (42.3%), 3.6 and 3.99 (17.7%), 4.0 (0.6%), credit units enrolled for semesters 1 and 6 (5.2%), 7 and 12 (37.7%), 13 and 18 (53.1%), 19 and 24 (2.9%), and 25 and above (1.1%).

Specifically, we used the *fit* command of Cusp R, *R > fit < -cusp(y ~ Acadmeicdishonesty, alphã Opportunity + Pressure, betã Pressure,+data=Academicdishoenesty, start=AcademicdishonestyStartingValues)* and the *summary* command *R> summary (fit, logist = TRUE)* to obtain a summary of the parameters and the associated statistics where *logist* is set *TRUE* to compare the cusp to the logistic curve fit, in addition to a comparison with a linear model. Parameter estimates are coefficients with respect to the standardized data. We also used the *scale* function of Cusp R to standardize the data (Chen & Chen, 2015).

### 4.3. H2: design and data collection

For Hypothesis 2, we designed a low-effort warning post (WP), as shown in Fig. 3, and posted it on individual students' learning management systems of an upper-division auditing class, labeled the WP group, but not posted in a parallel auditing class, labeled the NWP group. The WP group consisted of 32 students (14 males, 18 females), 3.1 average GPA, 24.7 average age, 97.2% senior, 2.8% graduate, 80.2% full-time, 19.8% part-time, 0.2% international, and average 14 credit units enrolled for the semester. The NWP group consisted of 30 students (16 males, 14 females), 3.2 average GPA, 24.2 average age, 98.0% senior, 2.0% graduate, 78.1% full-time, 21.9% part-time, 0.1% international, and average 14 credit units enrolled for the semester. Both the WP and NWP groups were taught by the same faculty, used the same course materials, and took the same ten in-class tests in fall 2019 before all in-class tests were suspended in spring 2020 due to the COVID-19 pandemic. Each of the ten in-class tests consisted of 30 multiple-choice questions. With regard to student subjects, the Institutional Review Board (IRB) approved the experiment under the Institutional Human Subject clause "Research conducted in educational settings involving normal educational practices." With regard to student privacy, Student Affairs affirmed the report to the Office of Student Conduct does not violate the Family Educational Rights and Privacy Act (FERPA) under the Permitted Disclosures clause "FERPA allows schools to disclose to … school officials with legitimate educational interest."

### 4.4. H2: Materials and Procedures

For each of the ten in-class tests, perceived pressure, the splitting variable $\beta$, was kept high by the following procedures: the faculty (1) scheduled a short 30 min (1 min for each multiple-choice question) high time pressure test (ref. D'Souza & Siegfeldt, 2017; Beck, 2014), and (2) allocated a large percentage of high-stakes test scores to the overall course grade (ref. Boyle et al., 2016; Nichols & Berliner, 2007). Perceived opportunity, the asymmetry variable $\alpha$, was kept low through the following procedures: the faculty (1) preassigned seats for the tests (ref. Bernardi & Higgins, 2020) and proctored all tests (ref. Alessio, Malay, Maurer, Bailer, & Rubin, 2017), (2) created the test questions (ref. Bain, 2015) and generated three versions of the test (ref. Bernardi et al., 2008), (3) conducted all the tests in class (ref. Underwood & Szabo, 2003) and paced classroom aisles (ref. Kerkvliet & Sigmund, 1999), (4) banned cell phones, ear phones, and ear buds during the tests (ref. Boehm, Justice, & Weeks, 2009) and requested that backpacks and handbags lay on the classroom floor (ref. Bernardi & Higgins, 2020), and (5) provided scantron cards and calculators for the tests (ref. Davis et al., 1992).

To note instances of abrupt academic dishonesty (AAD), the faculty constructed a make-believe paper shredder by tinkering a paper shredder to make the normal paper machine shredding sounds, but did not really shred a paper passing through it. The faculty also detached the make-believe paper shredder from its original see-through thrash can and attached it to a non-see-through office thrash container, as shown in Fig. 4.

Prior to each of the ten in-class tests, the faculty brought the make-believe paper shredder and a scantron-card scoring machine into the classroom. Upon completing each in-class test, the students first self-scored their tests using the scantron-card scoring machine. Next, they self-reported their scantron card scores to the faculty who recorded them without sighting or verifying their actual scantron card scores. Finally, students "shredded" their scantron card scores using the make-believe paper shredder before leaving the classroom.

Upon completing each of the ten in-class tests, the faculty returned to the office with the make-believe paper shredder, retrieved from it the supposedly shredded Scantron card scores, and noted differences between the supposedly "shredded" true scores and the recorded self-report scores for instances of AAD. To test Hypothesis 2, all noted instances of AAD were input into the following regression model.

$$\text{Abrupt Academic Dishonesty} = \beta_0 + \beta_1 \text{ Warning Post} + \beta_2 \text{ Gender} + \beta_3 \text{Test Difficulty} + \beta_4 \text{ Test Score} + \varepsilon.$$

The source and measurement of the variables are:

*Test Variable*. Abrupt Academic Dishonesty (AAD): A total of 620 test scores, 320 (32 students × 10 repeated measures) test scores from the warning post (WP) group and 300 (30 students × 10 repeated measures) test scores from the no-warning post (NWP) group. Code 1 for instances of a difference between the "shredded" true scores and recorded self-report scores and 0 otherwise.

*Independent Variable*. The Warning Post (WP) code is 1 for students in the WP class, and 0 otherwise. The class attendance sheet and official class roster were used to identify students belonging to WP or NWP classes.

*Control Variables*. Gender (G): Code 1 for male names and code 0 for female names. Where the G of a student's name was undeterminable, the student was contacted via email to correctly code the student's G. To address the concern that unisex names might lead to incorrect results, we used a comprehensive list of 1001 unisex names (https://listophile.com/names/unisex/) to identify two unisex names in the sample. We dropped them from the sample and reran the logistic regression analyses. The results remain unchanged. Test Difficulty (TD): Code 1 for low-difficulty test questions, 2 for moderate-difficulty test questions, and 3 for high-difficulty test questions. Two authors independently rated the TD for each test question. The Kappa statistic for inter-rater reliability is 0.83, which is in high agreement with the conventional 0.81–1.00 criterion values. All inter-rater disagreements were resolved. Test Score (TS): Test scores ranged from 0 points (all wrong answers) to 10 points (all correct answers). Zero points for no (blank) answers.

## 5. Results and discussion

### 5.1. H1: results and discussion

We used Grasman et al.'s (2009) statistical Cusp R software to fit the cusp catastrophe model Equation (#5) to the student-cheating data provided by Choo and Tan (2008). Table 3 shows that the coefficients of perceived pressure ($z = 8.676$, $p < 0.0001$), perceived opportunity ($z = 8.012$, $p < 0.0001$), and cheating ($z = 15.834$, $p < 0.0001$) were all significant and consistent with previous findings concerning the influence of pressure and opportunity as per the Fraud Triangle (e.g., Morris & Killian, 2006; Choo & Tan, 2008; Becker et al., 2006). In other words, the results validate the relevance of the Fraud Triangle in understanding the complex and nonlinear influences of perceived pressure and opportunity on AAD (Smith et al., 2022; Homer, 2020; Burke & Sanney, 2018; Dorminey et al., 2012; Albrecht et al., 2019).

Table 4 lists the results of the model fit statistics. The column labeled "*R*" gives conventional $R^2$ for the linear regression model and logistic curve model, and the pseudo-*R* statistic for the cusp model. The Akaike Information Criterion (AIC), Correction to the AIC for small sample size (AICc), and Bayesian Information Criterion (BIC) all indicate that the cusp model is the best fit for the data. The chi-squared likelihood ratio test showed that the cusp model was significantly better than the linear model with normal errors ($x^2 = 76.17$, $df = 181$, $p < 0.0001$). Thus, the cusp model is the best fit for hypothesis 1 in that the dependent behavioral state, AAD, transits from linear to nonlinear-abrupt (Isnard & Zeeman, 2019, pp. 3–19; Stewart & Peregoy, 1983) at high level of perceived pressure (e.g., Boyle et al., 2016; Daumiller & Janke, 2020; Guo, 2011; Hodgkinson et al., 2016) and low level of perceived opportunity (e.g., Cluskey et al.,

2011; Fask et al., 2014; Hollis, 2018). The findings imply that the existing linear models on cheating (e.g., Anderman et al., 2009; Becker et al., 2006; Glover, 1997) do not describe dishonesty behavior adequately as a function of perceived pressure and perceived opportunity.

We also used the command *cusp3d.surface( )* to generate a three-dimensional visual display of the folded-shape cusp catastrophe behavioral surface plane and bifurcation set. According to van der Maas et al.'s (2003) recommendation, for a cusp catastrophe to be evident, 10% of the observations must fall within the bifurcation area. Consistent with prior studies (e.g., Chen & Chen, 2015; Katerndahl, Burge, Ferrer, Wood, and Becho 2015; Mazanov & Byrne, 2006), the three-dimensional visual display shows strong evidence of a cusp catastrophe, with more than 15% of the observations falling in the bifurcation area. It also shows that a small change in either the splitting variable or the asymmetry variable at the bifurcation area causes abrupt behavior, which has been observed in many previous studies (e.g., Barunik & Vosvrda, 2009; Ceja & Navarro, 2012; Katerelos & Varotsis, 2017). Finally, the results suggest that to deter AAD, one must consider the intentions (Ajzen, 1991; Lonsdale, 2017) to cheat caused by perceived pressure, the splitting variable, and perceived opportunity, the asymmetry variable.

Taken together, these findings provide valuable insights into how the complex and nonlinear forces of perceived pressure and opportunity push students towards AAD in the classroom, thereby suggesting that the development of deterrence to AAD is in order. To that end, we designed, tested, and contributed original deterrence to the second hypothesis.

### 5.2. H2: results and discussion

An inspection of 620 raw data shows one abrupt academic dishonesty (AAD) student cheating three times, one cheating twice, and the remaining cheating only once. Thus, the majority of the AAD students came across as one-time "situational" cheaters (e.g., Brody, Melendy, & Perri, 2012; Hermanson, Justice, Ramamoorti, & Riley, 2017) at high (low) perceived pressure (opportunity) to cheat. Table 5 presents the descriptive statistics in Panel A, Pearson correlations in Panel B, and logistic regressions in Panel C. The logistic regression analyses in Panel C show that the low-effort warning post (WP) reduces the AAD ($z = -2.859$, $p < 0.05$). The variance inflation factor (VIF) and its tolerance value (1.2) showed low multicollinearity for a small set of explanatory variables. The inspection of the residuals showed that the data met the homoscedasticity assumption of the regression model. The adjusted R-squared value was reported because of the small sample of repeated measures (620 test scores). Lastly, since a small sample of repeated measures can potentially yield false-positive findings (i.e., an inflated significant WP effect), a Bonferroni post hoc adjustment (Forstmeier, Wagenmakers, & Parker, 2017) was used to contain such a false-positive WP effect. The adjusted Bonferroni $p$ value for WP remained the same $p < 0.05$. Thus, a small sample of repeated measures did not appear to inflate the WP effect.

To account for the *extent* of AAD, a cheating ratio (Atanasov & Dana, 2011) was computed by dividing the number of inflated correct scores an AAD student made by the number of inflated correct scores the student *could* have made (i.e., a maximum of 10). For example, an AAD student who had six correct scores could be maximally cheated by claiming four more correct scores but reported eight instead (i.e., inflated correct scores by two); the student's cheating ratio was then 0.50 (i.e., 2/4). A value of 0 indicated no cheating, whereas a value of 1 indicated cheating to the fullest extent possible. We then applied a non-parametric Friedman test (an alternative to a parametric one-way ANOVA with repeated measures), which showed that AAD students in the WP class inflated their test scores to a lesser extent than those in the NWP class (FM critical value was significant at $p < 0.05$). Collectively, the results support Hypothesis 2 that the WP in learning management systems that warns a dishonest student would be reported to the Office of Student Conduct significantly reducing AAD, thereby contributing to an original deterrence to abrupt academic dishonesty in the classroom. Additionally, the results imply that WP is not limited to offline tests; it is also effective for online tests as well (King & Case, 2014).

The AAD between male and female students was not significant ($z = 1.041$, $p =$ ns), which is consistent with the no-gender (G) effect reported in Athanasou and Olabisi's (2002) meta-analysis of 21 studies on cheating in classrooms in Japan, South Africa, and the USA. However, this effect remains inconclusive because of the continuous mixed findings that male students cheat more (e.g., Bernardi & Higgins, 2020; Bucciol & Piovesan, 2011; Hensley et al., 2013; Kremmer, Brimble, & Stevenson-Clarke, 2007; Lonsdale, 2017) or less (e.g., Lin & Wen, 2007; McCabe & Bowers, 1994) or the same (e.g., Abdolmohammadi & Baker, 2007; Diekhoff et al., 1996; Ifeagwazi, Chukwuorji, Egbodo, & Nwoke, 2019) than female students do.

AAD significantly increased with high test difficulty questions TD ($z = 4.436$, $p < 0.01$), which implies that AAD would likely increase with other high test difficulty variables, such as challenging majors (Brimble & Stevenson-Clarke, 2005), fear of failure (Alessio et al., 2018; Ifeagwazi et al., 2019), test anxiety (Chin, 2020; Etem, 2014), and worry about performance (Anderman, Griesinger, & Westerfield, 1998; Christie, 2003).

AAD significantly decreased with high test scores TS ($z = -0.192$, $p < 0.01$), which is consistent with many of the studies that found an inverse relationship between TS and cheating (e.g., Abdolmohammadi & Baker, 2007; Hensley et al., 2013; Miller, Murdock, Anderman, & Poindexter, 2007). However, a few studies have found no such relationship (e.g., Nowell & Laufer, 1997; Stephens, 2004; Whitley, 1998).

Additional logistic regression analyses in Table 6 showed no significant age (A) effect on AAD, which is consistent with some studies (e.g., Byrne & Trushell, 2012; Nazir & Aslam, 2010), but inconsistent with other studies (e.g., Becker et al., 2006; Diekhoff et al., 1996). These mixed findings seem to suggest that AAD is more a function of contextual factors, both social (Lucas & Friedrich, 2005) and psychological (Marsden, Carroll, & Neill, 2005), than age (Rest, 1994). Additional analyses in Table 6 also show no significant differences between the undergraduate/graduate (UG) students and AAD. This is not surprising, because many studies have found that both undergraduate and graduate students are involved in cheating in the classroom (e.g., McCabe et al., 2006; Minarcik & Bridges, 2015; Sheard et al., 2003). Lastly, part-time/full-time (PF) status and course load (CL) per semester are not related to AAD.

## 6. Limitations, contributions, and concluding remarks

### 6.1. H1: limitations

The findings for Hypothesis 1 have several limitations. First, there are the usual limitations associated with self-reported data, such as students' overreporting or underreporting of cheatings (Bretag et al., 2019; Watson & Sottile, 2010). In addition, self-reported behavior may not reflect actual behavior, such as students underestimating socially undesirable dishonesty behaviors (Kerkvliet, 1994). Second, the AAD model does not include students' dysfunctional variables in cheatings, such as their irrational rationalization (Brown, 2002; Griebeler, 2019), self-serving intuition (Kobis et al., 2019; Shu, Gino, & Bazerman, 2011), antisocial (Farrington, 2017; Meiseberg, Ehrmann, & Prinz, 2017) and neutralizing attitudes (Meng, Othman, D'Silva, & Zoharah, 2014; Peer et al., 2014), and wicked intentions (Lonsdale, 2017; Stone et al., 2010). Third, it is a bit of stretch to generalize a cusp catastrophe model to real-world AAD phenomena. However, the AAD model is simply a proxy for reality and not reality itself.

### 6.2. H2: limitations

The findings for Hypothesis 2 also have several limitations. First, the study only included gender (G), test difficulty (TD), and test score (TS) as control variables. Although it would have been beneficial to include a plethora of control variables, such as ethnicity, personality, IQ, moral reasoning, attitude, and motivation, it is not crucial to include them given the research question of interest at hand, which is to test whether low-effort WP reduces AAD. Of course, if the research question of interest were to predict AAD, it would have been necessary to include them. Second, the WP may not reduce AAD associated with irrational traits, such as "everybody does it!" (Dyer, Pettyjohn, & Saladin, 2020; Griebeler, 2019), "to succeed at all costs" (Brimble, 2016), and "to appear cool" (Faucher, 2009). However, recent empirical studies by psychologists and behavioral researchers have found that irrational traits are actually malleable traits that are heavily influenced by perceived psychological costs and situational deterrences (e.g., Hodgkinson et al., 2016; Marshall & Varnon, 2017). Thus, we recommend further research to investigate whether WP reduces AAD associated with malleable irrational traits. Third, this study tested whether WP reduces one type of cheating in academic tests. The results cannot be generalized to other types of cheating, such as plagiarisms (Comas-Forgas & Sureda-Negre, 2010) and fraudulent excuses (Patrzeka, Sattler, van Veenb, Grunschela, & Friesa, 2014). Fourth, low-effort WP may not work in different countries because of differences in culture (Osisiogu & Mamman, 2017), education systems (Thomas, 2017), motivation (Lin, Deng, Chai, & Tsai, 2013), mindset (Dweck, 2010), attitudes (Chapman & Lupton, 2004), and penalties (Nazir & Aslam, 2010), among others. Fifth, the WP speaks only to a reduction and not to a complete elimination of the AAD. Finally, as with many other studies in this area, a major limitation is that the results rely almost exclusively on a one-time regression analysis. Thus, longitudinal and replicate studies are needed for a more thorough understanding of the association between WP and AAD.

### 6.3. H1: contributions

The study of Hypothesis 1 has several contributions. First, it raises the awareness of nonlinear abrupt dishonesty behavior beyond linear dishonesty behavior that the extant literature has focused exclusively on (Isnard & Zeeman, 2019, pp. 3–19; Stewart & Peregoy, 1983; Deakin, 1980; Flay, 1978). Second, it provides the first empirical evidence on abrupt dishonesty behavior formulated on the cusp catastrophe model (Arnold, 2004, pp. 3–6; Poston & Stewart, 1996, pp. 174–176; Zeeman, 1976), and perceived pressure and opportunity of the Fraud Triangle (Smith et al., 2022; Homer, 2020; Dorminey et al., 2012; Albrecht et al., 2019). Third, it yields valuable insights into how the complex and nonlinear forces of perceived pressure and opportunity push students towards AAD in the classroom by defining AAD as the behavioral state (Cobb, 1981; Cobb & Watson, 1980), perceived pressure as the splitting variable $\beta$ (Dorminey et al., 2012) and perceived opportunity as the asymmetry variable $\alpha$ (Smith et al., 2022). Fourth, it suggests developing a deterrence specific to AAD since none existed in the literature (Austin & Brown, 1999; Happel & Jennings, 2008). To that end, we designed, tested, and contributed original deterrence to the second hypothesis.

### 6.4. H2: contributions

The study of Hypothesis 2 makes several contributions. First, it provides insights into the psychology of how to deter AAD based on Ajzen's theory that students' perceived psychological costs of being exposed reduce their intention to cheat (Ajzen, 1991, 2001, 2002; Beck & Ajzen, 1991; Stone et al., 2010; Thomas, 2015). Second, it contributes original deterrence to AAD when none of the existing deterrences in the extant literature are suitable for deterring AAD (e.g., Bernardi et al., 2008; Cluskey et al., 2011; Hollis, 2018). Third, it provides a low-effort WP that faculty can easily implement, and prior studies suggest that when the effort to implement deterrence is low, the frequency of faculty members applying that deterrence increases (e.g., Coren, 2011; Keith-Spiegel et al., 1998; Sattler et al., 2017). Fourth, it allows faculty to easily modify the design and implementation of the WP; for example, faculty could record a thumbnail video of the WP and email/text it to students (e.g., Reisslein, Seeling, & Reisslein, 2005).

### 6.5. Concluding remarks

This study has two main takeaways. First, a nonlinear cusp catastrophe model best describes the AAD. The model fit supports the hypothesis that students are involved in AAD at high (low) levels of perceived pressure (opportunity) to cheat, thereby yielding

valuable insights into how the complex and nonlinear forces of perceived pressure and opportunity push students towards AAD in the classroom. A practical implication of this finding is that faculty can minimize AAD by concurrently lowering perceived opportunity, for example, conducting all in-class tests (e.g., Underwood & Szabo, 2003) or banning cell phones, ear phones, and ear buds during the tests (e.g., Boehm et al., 2009), and perceived pressure, for example, switching from summative high-stakes assessments (e.g., Black, Harrison, Hodgen, Marshall, & Serret, 2011) to formative low-stakes assessments (e.g., Torrance & Pryor, 2001) or advising on good time management (e.g., Macan, Shahani, Dipboye, & Phillips, 1990). Second, the original low-effort WP in learning management systems supports the hypothesis that it would significantly reduce AAD based on students' perceived psychological costs of being exposed, thereby providing insights into the psychology of how to deter AAD in the classroom. A practical implication of this low-effort WP deterrence is that the faculty can easily modify its design and implementation in several ways. For example, faculty could draft the WP and ask for information technology support to design and upload it to a learning management systems such as Canvas or Blackboard (e.g., Lonn & Teasley, 2009), hand out printed copies of the WP to students in class instead of posting it in a learning management systems (e.g., Walker, Lindner, Murphrey, & Dooley, 2016), insert the WP as a pdf file in syllabi together with the university's official policy regarding academic dishonesty (e.g., Staats & Hupp, 2012) or record a thumbnail video of the WP and email/text it to the students (e.g., Reisslein et al., 2005).

## Declaration of comperting interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The authors do not have permission to share data.

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