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The General Self-Concept Prime

by

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Note: This dissertation has been written by Keri Kettle. Any reference to "we" anticipates joint submission to the target journal.

ABSTRACT

Each of us has a self-concept – the set of characteristics that reflect the type of person we are (Wakslak et al. 2008) – within which exist specific self-schema and self-identities that guide our behavior in different situations. It is well established that particular constructs and identities can be differentially activated (primed) through a variety of means, such as exposure to words (Bargh, Chen, and Burrows 1996), objects (Berger and Fitzsimons 2008), and images (McKee, Nhean, Hanson, and Mase 2006). Little is known, however, about whether – or how – multiple aspects of one's self-concept can be differentially or simultaneously primed by a single intervention. This dissertation introduces the general self-concept prime – the notion that a single intervention (such as signing one's name) can lead to the activation of one or more distinct aspects of one's self-concept. In three essays, I examine the general self-concept priming effect of signing one's name, investigate how a general self-concept prime influences performance and other behaviors, and identify other interventions that serve as general self-concept primes.

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CHAPTER 1: INTRODUCTION

Each of us has a self-concept – a set of self-identities and self-schemas that, together, form the person we perceive ourselves to be (Bem and Allen 1974; Butterworth 1992; James 1890; Wakslak, Nussbaum, Liberman, and Trope 2008). By enabling us to define who we are, a self-concept is central to our existence as human beings: it shapes our thoughts and actions, it serves as a lens through which we interpret the environment and our experiences, and it drives us to behave with some consistency across a variety of situations.

As an intricate combination of distinct self-identities and self-schemas that vary along a multitude of dimensions, the self-concept is a difficult construct to research, as only a small subset of the many aspects of your self-concept may be afforded (and thus readily examined) at a particular point in time. Consequently, behavioral researchers have tended to focus their efforts on paradigms in which particular, readily identifiable self-schemas and/or self-identities are afforded, and on examining how behavior is affected by the differential activation (i.e., priming) of those particular aspects. The activation of schemas and identities has been achieved through a number of different interventions, such as exposure to schema- or identity-relevant cues (Bargh and Williams 2006; Forehand and Deshpandé 2001; Forehand, Reed, and Deshpandé 2002; Purdie-Vaughns et al. 2008; Wilder and Shapiro 1984, 1991), or engagement in identity- or schema-relevant actions (Mussweiler 2006; Schubert and Koole 2008). It is well-established that particular identities and schemas can be primed, and that doing so will influence subsequent behavior in a predictable manner (DeMarree, Wheeler, and Petty 2005; Wheeler and Berger 2007; Wheeler and DeMarree 2009). Recent work has provided greater insight into how characteristics of the priming manipulations and the situation influence the magnitude and the

direction of prime-to-behavior effects (Dijksterhuis et al 1998; Sela and Shiv 2009; Shih et al. 2002). Little is known, however, about whether one's entire self-concept – or multiple aspects thereof – can be primed by a single intervention and, if so, how such an intervention might predictably influence behavior.

This dissertation introduces the general self-concept prime – a single intervention (such as signing one's name) that can lead to the activation of any of the distinct aspects of one's self-concept. In three essays I demonstrate that signing one's name leads to the activation of the aspect of one's self-identity that is relevant in the present situation (chapter 2), I examine how a general self-concept prime influences math performance (chapter 3), and I identify an essential property of a general self-concept prime and find two novel interventions (typing one's password and entering one's PIN) that also serve as general self-concept primes (chapter 4).

In this dissertation, I use two different terms – general self-identity prime and general self-concept prime – to describe the set of behavioral phenomenon that arise from engagement in the act of signing one's name. The use of these different terms does not reflect an inconsistency in my theoretical account of the phenomenon, but instead results from the temporal sequence in which the essays were completed. My initial theorizing – reflected in chapter 2 – was that signing one's name serves as an identity prime (because signing is a means to verify one's identity). After the manuscript that comprises chapter 2 had already been accepted for publication, I completed experiments 2-4 from chapter 3; results from these studies provide strong evidence that the behavioral phenomenon of signing is not restricted to specific identities, but is better characterized as the activation of one's self-concept (which includes self-schema that are not necessarily associated with a particular identity). Thus, the development of the term

general self-concept prime reflects my enhanced understanding of the phenomenon, rather than an inconsistency in my theorizing.

This dissertation makes a number of contributions to research in marketing and psychology. First, it introduces the notion that a single innocuous intervention – such as signing one's name, typing one's password, or entering one's PIN – can serve as a general self-concept prime that interacts with situational affordances to influence one's behavior in a predictable manner. This discovery enhances our understanding of the meaning imbued in the different means that people use to verify their identity, and it provides behavioral scientists with remarkably simple interventions that enable them to tap into their subjects' self-concepts. The power of the general self-concept prime is particularly noteworthy when contrasted with the litany of complex priming interventions – such as scrambled-sentence tasks and subliminal priming methods – currently employed by behavioral researchers.

Second, this dissertation sheds new light on the role of situational affordances in prime-to-behavior effects by identifying conditions under which people are more or less responsive to identity-relevant affordances. This research contributes to recent work that indicates that environmental cues can influence behavior by activating relevant constructs (Berger and Fitzsimons 2008). In particular, the present dissertation demonstrates that individuals can respond differently to the same affordance as a function of whether their self-concept has been generally primed by engagement in an identity-relevant motor action.

Third, the general self-concept prime makes an important contribution to behavioral science research by introducing a single intervention that enables researchers to tap into the aspect of one's self-concept that is relevant in the present situation. In contrast to other identity priming interventions, which have been shown to promote identity-congruent behavior in

individuals who do not possess the primed identity as part of their self-concept (Aronson et al. 1999; Wheeler and Petty 2001), the general self-concept prime activates an aspect of one's own self-concept. Essay 2 represents an initial investigation into conditions in which the self-concept of females aligns with the stereotype typically associated with the female identity – poor math skills. Whereas priming the female gender has been shown to hinder the math performance of both females and males, a general self-concept prime hinders the performance of individuals who perceive themselves to lack math talent. A general self-concept prime thus hinders the math performance of females only in populations where females perceive themselves to lack talent in solving math problems. This difference suggests that the general self-concept prime may provide researchers with the power to determine whether a particular identity or stereotype is actually a part of one's self-concept, rather than assuming that it is.

This dissertation represents an important first step towards the development of a comprehensive theory of the general self-concept prime. Results from twelve studies clearly demonstrate that signing one's name acts as a general self-concept prime, and provide an initial demonstration of two additional behaviors – typing one's password and entering one's PIN – that share key characteristics with signing, and thus influence behavior in a manner that is consistent with the general priming of one's self-concept. There remains much work to be done, however, to identify a broader set of interventions that serve as general self-concept primes. Furthermore, although eleven studies suggest that a general self-concept prime produces assimilation effects (in that it generates behavior that is congruent with the aspect of one's self-concept that is relevant in the present situation), results from two studies (study 4 of essay 2, and study 1 of essay 3) hint at conditions in which a general self-concept prime may generate contrast effects.

This dissertation sets in motion a research program that should lead to the development of a theory of the general self-concept prime.

The remainder of this dissertation is organized as follows. In Chapter 2 I introduce the finding that signing one's name acts as a general self-identity prime that enables situational affordances to activate the relevant aspect of one's self-identity. Signing their name thus leads consumers to behave in a manner congruent with the specific aspect of their self-identity that is afforded by the situation. Results from four studies show that signing one's name – in an ostensibly unrelated task – promotes behavior that is congruent with how closely one associates his or her identity with a product domain (studies 1 and 2), and with one's social identity (studies 3 and 4).

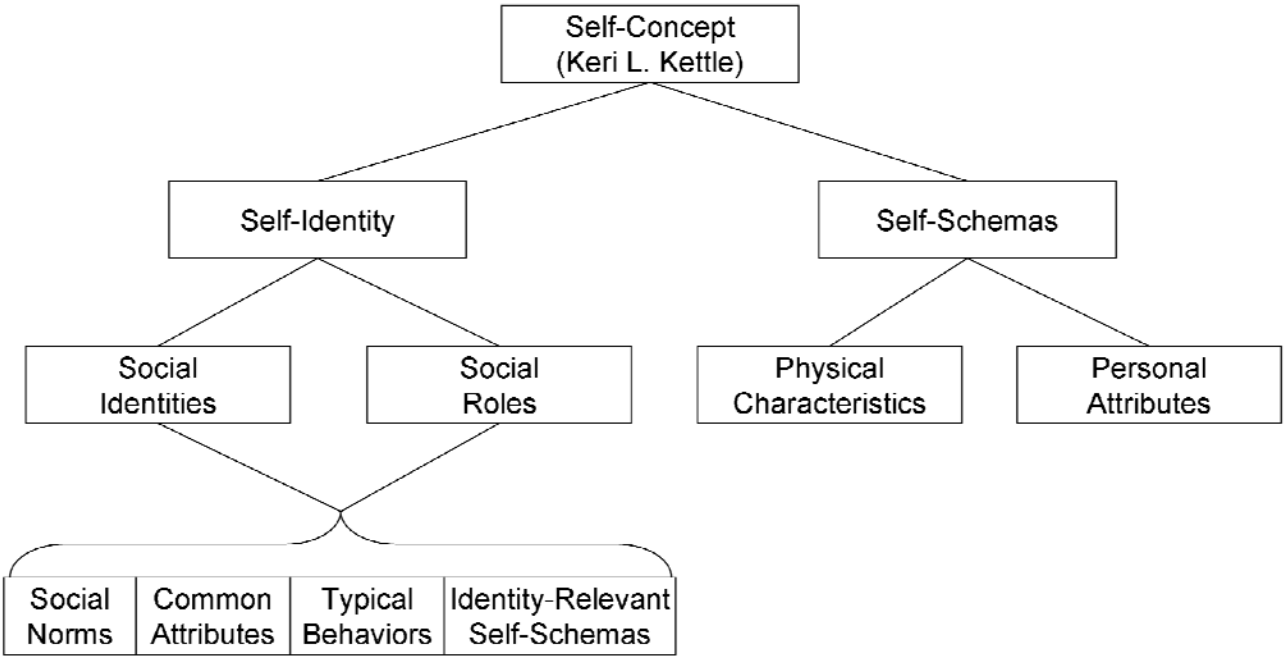
In Chapter 3, I examine how a general self-concept prime influences thoughts and behavior in the domain of math performance. I show that a general self-concept prime – such as signing one's own name – can influence academic performance in a manner that is consistent with stereotype activation, but that this effect is driven by the activation of one's self-concept, rather than the stereotype. Studies 1 and 2 demonstrate that merely signing their name can induce females (but not males) to perform worse at solving graduate-level math problems (study 1), but only to the extent that they perceive themselves as not talented at math (study 1). Study 3 examines quantitatively skilled students (accounting students), and shows that a general self-concept prime induces a gender gap by enhancing the performance of males. Study 4 shows that signing one's name does not itself activate these self-schemas, but rather that the situational cue (i.e., the math problem) is necessary to activate the relevant aspects of one's self-identity.

In Chapter 4, I take a first step toward identifying what types of interventions that can act as general self-concept primes. In three studies, I demonstrate that the general self-concept

priming effect is produced by engagement in an identity-relevant action, but not exposure to an identity-relevant image (e.g., of one's signature), and identify two identity-relevant actions – typing one's primary password and entering one's Personal Identification Number (PIN) for banking – that may serve as general self-concept primes. Using an identity-signaling paradigm, studies 1 and 2 demonstrate that the physical action of producing one's signature – whether done wearing a blindfold or with a capped pen – replicates the self-concept priming effects generated by signing one's name under normal conditions (i.e., with a functioning pen on a piece of paper). By contrast, exposure to one's previously signed name on paper does not. Building on these results, study 3 identifies two identity-relevant actions that serve as general self-concept primes: typing one's password and entering one's PIN.

Finally, in Chapter 5 I summarize the contributions that this dissertation makes to the fields of marketing and psychology. I also discuss theoretical implications for researchers in the behavioral sciences, and practical implications for consumers, marketers, educators, and for public policy. Finally, I discuss several avenues for future research.

FIGURE 1. SELF-CONCEPT



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CHAPTER 2: THE SIGNATURE EFFECT[1]

ABSTRACT

Evidence from four studies shows that signing one's name influences consumption-related behavior in a predictable manner. Signing acts as a general self-identity prime that facilitates the activation of the particular aspect of a consumer's self-identity that is afforded by the situation, resulting in behavior congruent with that aspect. Our findings demonstrate that signing causes consumers to become more (less) engaged when shopping in a product domain they (do not) closely identify with (studies 1 and 2), to identify more (less) closely with in(out)-groups (study 3), and to conform more with (diverge more from) in(out)-groups when making consumption choices in preference domains that are relevant to signaling one's identity (study 4). We discuss the theoretical and practical implications of these findings.

[1] A version of this essay has been accepted for publication. Kettle, Keri L., and Gerald Häubl (2011), "The Signature Effect: Signing Influences Consumption-Related Behavior by Priming Self-Identity," *Journal of Consumer Research*, 38 (October).

Your handwritten signature plays an important role in your life. As a consumer, you often sign your name on documents to authorize, initiate, or complete transactions (e.g., credit card purchases). Moreover, by signing particular documents, you can commit yourself to years of marriage, mortgage payments, or military service. In this article, we examine the possibility that the mere act of signing your name might influence your consumption-related behavior, such as how much time you spend in a retail store or what you buy there. We introduce and test a theoretical account of how signing affects subsequent behavior.

We propose that signing one's name acts as a general self-identity prime. Here, the term *self-identity* refers to the totality of all selves, identities, and schemas that form one's sense of self (Markus 1977). Building on the theory of affordances (Gibson 1977; Greeno 1994), we hypothesize that the general priming of one's self-identity (as a result of producing one's signature) makes it more likely that situational affordances activate the relevant *aspect* of one's self-identity, and that this in turn leads to behavior that is congruent with the activated aspect.

Evidence from four studies demonstrates this phenomenon in consumption-related domains. Signing their name – as opposed to printing it – in an ostensibly unrelated task induces consumers to become more (less) engaged when shopping in a product domain they (do not) closely identify with (studies 1 and 2), leads people to identify more closely with in-groups and less closely with out-groups (study 3), and causes consumers to conform more with in-groups and diverge more from out-groups when making consumption choices in preference domains that are relevant to signaling one's identity (study 4). These findings have important marketplace implications. For instance, a retailer might predictably influence the shopping behavior of its customers by eliciting their signatures.

SIGNATURES AND IDENTITY

A basic premise that underlies our theorizing is that individuals strongly associate their signature with their identity. Although there are numerous ways in which people may present their identity to others, signing one's name has distinct legal, social, and economic implications (Fraenkel 1992; Harris 2000). Individuals must often sign their name in situations where printing it would not be sufficient, such as when they authorize actions (e.g., the purchase or sale of financial instruments), indicate their understanding of a document (e.g., a consent form), or commit to the terms of a contract (Kam, Gummadidala, Fielding, and Conn 2001; Knapp, Crystal, and Prince 2003; Mann 1994; McCabe, Trevino, and Butterfield 1996; Mnookin 2001; Parizeau and Plamondon 1989).

Some of society's most important documents – including judges' rulings (LaFave and Remington 1964), corporate tax returns (Weinberg 2003), government legislation (Jackson and Roosevelt 1953), and contracts (Knapp et al. 2003) – require signatures to be official. As a result, handwritten signatures are often used as evidence of one's actions and obligations in courts of law (Mnookin 2001; Risinger, Denbeaux, and Saks 1989; Weinberg 2003), and it is illegal to forge another person's signature (Lemert 1958). By contrast, printing one's name on a document does not imbue the same meaning, nor is it illegal to print another person's name. Moreover, prior research suggests that the legal significance of signatures is widely understood and that forging someone else's signature causes physiological responses that reflect the experience of guilt (Lubow and Fein 1996).

The act of signing one's name is a highly expressive behavior (Harvey 1934; Warner and Sugarman 1986; Zweigenhaft and Marlowe 1973), and people tend to craft a signature that is clearly distinguishable from others' signatures and thus difficult to forge (Bensefia, Paquet, and

Heutte 2005; Kam et al. 2001). Consistent with our premise that individuals strongly associate their signature with their self-identity, people believe that the unique manner in which they sign their name reflects their personality and character traits (Briggs 1980; Hughes, Keeling, and Tuck 1983; King and Koehler 2000; Rafaeli and Klimoski 1983). Moreover, research indicates that the size of one's signature can be influenced by particular aspects of one's self-identity. In particular, signatures tend to be larger for people with greater need-for-uniqueness (Snyder and Fromkin 1977), with more dominant personalities (Jorgenson 1977), and of higher social status (Aiken and Zweigenhaft 1978), and in situations in which one's self-esteem is higher (Rudman, Dohn, and Fairchild 2007; Stapel and Blanton 2004; Zweigenhaft 1977).

Research in several domains has examined how signing a particular document – such as a contract or honor code – influences behavior as it pertains to the signed document. For instance, students who were required to sign a university's honor code subsequently acted more honestly (Mazar, Amir, and Ariely 2008; McCabe and Trevino 1993, 1997; McCabe et al. 1996), and requiring people to sign a contract (about a specific target behavior) has been shown to increase their conformity to the contract terms in behavioral domains ranging from weight loss to seat belt use (Anker and Crowley 1981; Rogers et al. 1988; Staw 1974; Stevens et al. 2002; Ureda 1980; Williams et al. 2005). Notably, in these studies (with the exception of Anker and Crowley 1981 and Staw 1974), behavior was influenced even though violating the contract or honor code was legally and economically inconsequential. This highlights the important meaning associated with signing one's name on a document and, thus, supports the premise of a strong relationship between signatures and identity.

In sum, prior work in several fields supports our premise that people strongly associate their signature with their identity. We now turn to developing the proposition that signing one's

name acts as a general self-identity prime, and to outlining how we envision this to predictably influence consumption-related behavior.

SELF-IDENTITY, PRIMING, AND BEHAVIOR

Each of us has a sense of who we are. We perceive ourselves as having (or lacking) certain physical attributes, character traits, and abilities, and we believe that we belong to certain social groups (and don't belong to others). Several different terms have been used in the literature to describe this overall sense of self, including "self-identity", "identity", "self", and "self-concept" (e.g., Belk 1988; Ellemers, Spears, and Doosje 2002; Gecas and Burke 1995; Howard 2000; James 1890; Lewicki 1984; Markus and Kunda 1986; Markus and Wurf 1987; Roberts and Donahue 1994; Rochberg-Halton 1984; Segal 1988; Thoits 1983). We use the term *self-identity* to refer to all of the selves, identities (including social identities), and self-schemas that comprise people's sense of who they are. As an illustration of this conceptualization, figure 1 represents our fictional character Amanda's (partial) self-identity, which includes multiple aspects – her gender identity, her social identities, and her identities as a runner and a photographer – as well as the schemas associated with each of these aspects.

Prior research has shown that aspects of one's self-identity can be differentially activated, and that the activation of a particular aspect makes it more likely that one's subsequent responses are congruent with that aspect (Berger and Heath 2007; DeMaree, Wheeler, and Petty 2005; Forehand, Reed, and Deshpandé 2002; Reed 2004; Sela and Shiv 2009; Wheeler and Petty 2001). For example, priming consumers' ethnicity leads them to respond more favorably to same-ethnicity spokespeople (Forehand and Deshpandé 2001), and priming a relevant out-group leads people to diverge from that group's behavioral norms (Spears et al. 2004). Although the nature of prime-to-behavior effects is well-established for contexts in which a specific identity

(e.g., gender) or schema (e.g., hostility) is primed, little is known about how a general self-identity prime – such as signing one's name – might influence behavior.

In order for a prime to affect a person's behavior, the situation s/he is in must provide an *affordance* – i.e., a precondition for activity that is available to an individual's perceptual systems – that is associated with the primed construct (Dijksterhuis and Bargh 2001; Gibson 1977; Greeno 1994; Guinote 2008; Oyserman 2009). Affordances thus serve as cues in the environment that can guide judgments and behavior (Cesario et al. 2010; Greeno 1994; Guinote 2008). For instance, evaluating advertisements featuring same-ethnicity spokespeople affords consumers' ethnic identity, with the ads serving as identity-relevant cues (Forehand and Deshpandé 2001). The role of affordances has received little attention in the priming literature – presumably because the necessity of affordances is implicitly reflected in the design of most priming studies (for a recent exception, see Cesario et al. 2010). In the context of a general self-identity prime, affordances are crucial because only certain aspects of one's self-identity may be relevant in a given situation. Using Amanda as an example, the running aspect of her identity is afforded at a sporting goods store, whereas the business student aspect is afforded in a marketing class.

Our key hypothesis is that signing one's name acts as a general self-identity prime, and that this interacts with the situational environment to activate – and thus promote behavior that is congruent with – the aspect of one's self-identity that is afforded (i.e., cued) by the situation. For example, imagine that Amanda enters a specialty sporting goods store for runners. In this case, our prediction is that signing her name makes it more likely that the situational affordance (i.e., the opportunity to shop for running gear) will activate the relevant aspect of her self-identity (i.e., being a runner) and, thus, cause her behavior in the store to be more congruent with her runner

identity (e.g., spend more time looking at running shoes). Our theoretical account thus implies concrete predictions about a variety of behavioral consequences, depending on the particular situation that an individual is in. In this article, we test such specific predictions about consumption-related behavior in several domains.

OVERVIEW OF STUDIES

We present evidence from four studies that examine the effect of signing one's name in situations that afford different aspects of a consumer's self-identity – strength of identification with particular product domains (studies 1 and 2) and social identities (studies 3 and 4). In each study, participants were randomly assigned to either sign or print their own name on a blank piece of paper (ostensibly for a separate study about handwriting) before entering the focal situation. The first two studies examine how signing their name influences the relationship between how closely consumers associate their self-identity with a specific product domain and their level of engagement in a shopping task in that domain, both in a controlled laboratory setting (study 1) and in an actual retail environment (study 2). This is followed by study 3, which investigates how signing affects how closely people identify with referent social groups. Finally, study 4 examines how signing their name influences the extent to which consumers signal their social identity through their product choices.

STUDY 1

It is well-established that consumers use products and possessions to help define aspects of their self-identity (Kleine, Kleine, and Allen 1995). Consumers have relationships with particular brands (Fournier 1998), they signal their social identity to others through the products they choose (Berger and Heath 2007; White and Dahl 2007), their extended selves include possessions (Belk 1988), and they consider their engagement in certain activities – and the use of

products that are relevant to these activities – to be central to their sense of self (Ahuvia 2005; Vallerand et al. 2003). Because people are highly engaged with products and activities that they associate with their self-identity (Tyler and Blader 2003), it is congruent with one's identity to be more (less) behaviorally engaged when shopping in a product domain that is close to (distant from) one's sense of self. Based on our overall hypothesis that signing one's name acts as a general self-identity prime, we predict that signing their name causes consumers to become more engaged when shopping in a product domain that they associate closely with their self-identity, and less engaged in a domain that is distant from their sense of self.

To test this prediction, we examine the engagement of consumers in a shopping task as a function of how closely they associate the product domain with their self-identity. We selected two products – digital cameras and dishwashers – that are similar in terms of their technical complexity, price, and the frequency with which they are used, but that we expected to be more (cameras) or less (dishwashers) closely associated with consumers' self-identities.

Method

Participants. A total of 57 undergraduate students at the University of Alberta completed a series of studies for partial course credit.

Design. A 3 (handwriting task: sign, print name, control) × 2 (product category: cameras, dishwashers) between-subjects design was used.

Handwriting Manipulation. Each participant was given two sheets of paper (stapled together) and a pen. The top sheet contained a set of instructions, and a cover story indicating that this was part of a study about handwriting. The bottom sheet contained the instructions

"Please sign (print) your name on the line below" at the top of the page, followed by a single blank line.

Procedure. The study was conducted in a university research laboratory. Participants began the study seated in private cubicles. First, they were randomly assigned to a handwriting condition. For the sign and print treatments, participants either signed or printed their name once. Participants in the control condition received the same written instructions as those in the signature condition, with one exception – the last sentence stated "Therefore, you will be asked to sign your name later in this session." Participants then proceeded to the second (ostensibly unrelated) portion of the study.

In the focal task, participants were randomly assigned to a product category (cameras or dishwashers). They were presented with three products from that category and asked to choose their preferred one from this set. Each of the three alternatives was described along 15 attribute dimensions. The descriptions of the three products were provided on a computer screen that was organized as a table with one row per attribute dimension and one column per alternative. For each alternative, its brand and model name, a product image, and its price were permanently displayed across the top of the table. The 45 pieces of attribute information were initially hidden, with 45 buttons appearing in their place in the table. Participants were told that they could inspect whichever pieces they wished by clicking the appropriate buttons. Once inspected, a piece of attribute information remained visible for the remainder of the task. Participants were informed that they were free to complete the task by selecting their preferred alternative whenever they felt ready to make their choice.

For each of the two product categories, three alternatives and their descriptions (see appendix A) were selected from the assortment of a large online retailer about a week before the

study. For each participant, the alternatives and attribute dimensions were randomly assigned to the columns and rows of the table.

After choosing their preferred alternative, participants were directed to complete an unrelated task that took approximately 10 minutes. Participants then answered a series of questions about the product category (cameras or dishwashers) to which they had been assigned for the focal task. These included measures of how frequently they use the product (1 = never, 10 = frequently), their level of expertise regarding the product domain (1 = novice, 10 = expert), how important the product domain is to them (1 = not at all important, 10 = very important), and how closely they associate their self-identity with the product domain (1 = distant, 10 = close). Participants' responses to these four questions were combined to form a composite measure of how closely they associated their sense of self with that particular product domain ($\alpha = .80$), which we refer to as "identity-product closeness."

Results

Preliminary Analyses. A 2 (product category: cameras vs. dishwashers) × 3 (handwriting task: sign vs. print name vs. control) ANOVA was used to examine the level of identity-product closeness for each of the two product categories. As expected, participants associated their self-identity much more closely with digital cameras ($M_{cam} = 5.5$) than with dishwashers ($M_{dish} = 3.7$, $F(1,51) = 8.8$, $p < .01$). This effect was not moderated by the handwriting task ($p = .75$), nor did the handwriting task have a main effect on identity-product closeness ($p = .83$).

Hypothesis Tests. Two measures of participants' engagement in the shopping task were obtained in this study – the amount of information they inspected and the amount of time they

spent on the shopping task. On average, participants examined 30 pieces of attribute information (*Min* = 10, *Max* = 45) and spent 2.6 minutes on the shopping task (*Min* = 1, *Max* = 5).

First, we examine the amount of information inspected by participants. A two-way ANOVA reveals a significant handwriting task × product category interaction ($F(5,51) = 5.2$, $p < .01$; see figure 2). A series of planned contrasts support our hypothesis that signing one's name promotes identity-congruent behavior. First, across product categories, participants who had signed their name differed, in terms of their engagement, from those who had printed their name ($F(1,34) = 9.4$, $p < .01$) as well as from those in the control condition ($F(1,35) = 6.5$, $p = .01$), with no difference between the latter two conditions ($p = .64$). Consequently, we contrast the signature condition with the two other conditions combined. As predicted, for the product category more closely associated with consumers' self-identity (i.e., cameras), signing one's name caused significantly greater engagement in the shopping task ($M_{sign\_cam} = 36.9$ attributes, $M_{other\_cam} = 24.1$; $F(1,32) = 8.6$, $p < .01$) whereas, for the product category less closely associated with participants' self-identity (i.e., dishwashers), signing resulted in marginally less engagement ($M_{sign\_dish} = 24.4$, $M_{other\_dish} = 34.4$; $F(1,21) = 3.0$, $p = .10$).

Next, we examine the time-based measure of engagement in the shopping task using a two-way ANOVA. The shopping time data exhibited a right skew due to their inherent left-truncation (non-negativity constraint) and were log-transformed for analysis (Bargh & Chartrand 2000). (For clarity of exposition, we present all time-based results in original units. However, all statistical tests are based on models estimated on log-transformed data.) A marginally significant handwriting task × product category interaction emerges ($F(2,51) = 2.45$, $p = .09$). Planned contrasts support our theory. Across product categories, participants who had signed their name differed significantly, in terms of the amount of time spent on the task, from those in

the control condition ($F(1,35) = 3.9$, $p < .05$, one-tailed), and differed marginally from those who had printed their name ($F(1,34) = 2.5$, $p = .06$, one-tailed), with no difference between the latter two conditions ($p = .60$). As predicted, for cameras signing caused marginally greater engagement in the shopping task ($M_{sign\_cam} = 2.8$ minutes, $M_{other\_cam} = 2.1$; $F(1,32) = 1.7$, $p = .10$, one-tailed) whereas for dishwashers – the category less closely associated with participants' self-identity – signing led to significantly less engagement ($M_{sign\_dish} = 1.7$, $M_{other\_dish} = 2.2$; $F(1,21) = 3.79$, $p < .05$, one-tailed).

Discussion

Consistent with our theoretical account of the behavioral consequences of signing one's name, producing their signature caused participants in study 1 to behave in a manner congruent with the afforded aspect of their self-identity – it increased their engagement when shopping in a product domain that they associate closely with their self-identity, but it decreased their engagement in a domain that is distant from their self-identity. The results of this study also demonstrate that signing – but not printing – one's name changes behavior relative to a control group in which people neither sign nor print their name. In the next study, we also examine how signing impacts the effect of how closely consumers associate a product domain with their self-identity on their engagement while shopping in that domain, but we do so in a retail setting.

STUDY 2

This study examines consumers' engagement while shopping in a field setting. Participants were sent to a specialty retail store (the name of which includes the word "Running") to choose a pair of running shoes for themselves. Based on our hypothesis that signing one's name makes it more likely that situational affordances activate the relevant aspect

of one's self-identity and, thus, leads to behavior congruent with the afforded aspect, we predict that signing leads to greater engagement with the shopping task for consumers who identify closely with running, and reduces engagement for consumers who do not identify with running.

Method

Participants. A total of 53 members of a volunteer research participation panel at the University of Alberta were recruited to complete a series of studies for a monetary reward.

Design. A two-level single factor (handwriting task: sign, print name) between-subjects design was used.

Procedure. The study involved two stages. The first was conducted in a university research laboratory, and the second took place at a retail store. In the first stage, participants were seated in private cubicles. Using a computer interface, they were (along with a large number of unrelated questions) asked to indicate their level of expertise with respect to running (1 = novice, 10 = expert), how frequently they run (1 = never, 10 = frequently), how interested they are in running (1 = not at all interested, 10 = very interested), and how close running is to their sense of self (1 = distant, 10 = close). Participants' responses to these four questions were combined to form a composite measure of how closely they associated their self-identity with running ($\alpha = .76$), which we refer to as "identity-running closeness." Before they began the second stage of the study, participants completed a series of unrelated studies for approximately 45 minutes.

At the beginning of the second stage of the study, participants received directions to a coffee shop that was approximately a ten-minute walk from the laboratory. They were instructed to walk there (individually) to meet another researcher. Upon arrival at the coffee shop,

participants were randomly assigned to one of the two treatment conditions of the handwriting task – i.e., asked to either sign or print their name five times (for a study about handwriting). After completing the handwriting task, participants were given instructions for an ostensibly unrelated study about running shoes. These instructions read as follows:

> "Your next task is to go to {name of store} located 1 block south on {name of street}. We want you to choose a pair of running shoes for yourself. Your choice is consequential. One participant in this study (selected at random) will receive his/her chosen pair of shoes and a cash amount equal to $200 minus the price of the shoes.
>
> For example:
>
> - If your shoes cost $90, you will receive the shoes and $110 in cash.
> - If your shoes cost $190, you will receive the shoes and $10 in cash."

Participants were instructed to return to the coffee shop as soon as they had selected their preferred pair of running shoes. Once they arrived back at the coffee shop, they completed a brief questionnaire in which they were asked to indicate the number of pairs of shoes they tried on in the store, the brand name of the shoe they selected (e.g., Nike), its model name (e.g., Air III), and its pre-tax price. The amount of time each participant spent in the store was measured and recorded inconspicuously.

Results

Two measures of participants' engagement in the shopping task were obtained in this study – the number of pairs of running shoes they tried on and the amount of time they spent in the store. On average, participants spent 11.7 minutes in the store (*Min* = 5, *Max* = 30) and tried on 1.1 pairs of running shoes (*Min* = 0, *Max* = 5).

First, we estimated a mixed-effects Poisson regression with the number of pairs of shoes tried on as the dependent variable and handwriting task (sign vs. print name), identity-running

closeness, and their interaction as independent variables. This analysis reveals a significant handwriting task × identity-running closeness interaction ($\beta = 0.32$, $p < .05$; see figure 3). To shed light on the nature of this interaction, we examine the effect of identity-running closeness on the number of pairs tried on for each handwriting condition. As hypothesized, for participants who had signed their name, identity-running closeness had a significant positive impact on how many pairs of running shoes they tried on in the store ($\beta = 0.30$, $p < .001$), whereas no such effect was observed for those who had printed their name ($p = .83$). A spotlight analysis (Aiken and West 1991; Fitzsimons 2008) at 1.5 standard deviations above the mean of identity-running closeness reveals that, as predicted, for consumers who closely associate their identity with running, signing (vs. printing) their name caused an increase in the number of pairs of running shoes they tried on ($\beta = 0.79$, $p < .05$). The corresponding analysis at 1.5 standard deviations below the mean indicates that, as hypothesized, for consumers who do not associate their identity with running, signing led to a reduction in the number of pairs of running shoes they tried on ($\beta = -1.07$, $p < .01$).

To examine the time-based measure of engagement in the shopping task, we regressed the (log-transformed) amount of time participants spent shopping for their pair of running shoes on the same set of independent variables. The results corroborate those for the number of pairs tried on. The handwriting task × identity-running closeness interaction is marginally significant ($\beta = 0.14$, $p = .06$). As predicted, for participants who had signed their name, identity-running closeness had a significant positive influence on how much time they spent shopping ($\beta = 0.10$, $p < .05$), whereas this relationship was not significant in the print condition ($p = .45$). Spotlight analyses at 1.5 standard deviations above and below the mean of identity-running closeness reveal that, as hypothesized, for consumers who closely associate their identity with running,

signing increased the amount of time they spent shopping for their pair of running shoes ($\beta = 0.46$, $p < .05$, one-tailed), whereas for consumers who do not associate running with their self-identity, signing reduced the amount of time spent shopping ($\beta = -0.38$, $p < .05$, one-tailed).

Discussion

The results of studies 1 and 2 support our hypothesis that signing one's name acts as a general self-identity prime. Evidence from three different product domains (digital cameras, dishwashers, and running shoes) shows that providing their signature induces consumers to behave in a manner congruent with the afforded aspect of their self-identity. Signing their name caused participants who associated a product domain more (less) closely with their self-identity to become more (less) behaviorally engaged when shopping in that domain – it led to an increase (decrease) in the number of pieces of product information inspected, in the number pairs of shoes tried on, and in the amount of time spent shopping in a retail store.

Although these findings are fully consistent with our theoretical account of the signature effect, direct evidence that signing activates the specific aspect of one's self-identity that is afforded by the situation would provide even stronger support for this account. To that end, studies 3 and 4 were designed to allow a more conclusive assessment of the proposed mental mechanism, and they do so by examining the effect of signing one's name on behavior in connection with consumers' social identities.

STUDY 3

Each of us possesses *social identities* – associations with social groups – that are central to how we view ourselves (Tajfel 1974). We define ourselves through our membership in some groups ("in-groups") and our non-membership in others ("out-groups"). Based on our overall

theoretical account that signing makes it more likely that situational affordances activate the relevant aspect of one's self-identity, we hypothesize that signing one's name in a context that affords a particular social identity activates one's identification with the afforded social group.

In this study, some participants were asked to name a social group to which they belong (i.e., an in-group), whereas others were asked to name a social group to which they do not belong (i.e., an out-group). All participants then responded to three questions pertaining to the specific group that they had selected – how closely they identify with the group, how much they like its members, and how similar they believe they are to its members.

We have two key predictions. First, based on the notion that signing activates one's identification with the afforded social group, we predict that signing their name leads participants to identify more (less) closely with the in-group (out-group). Critically, because our theory predicts that signing activates the association between one's self-identity and the afforded social group, signing should not moderate how much one likes members of each type of group, nor how similar one feels to the members of these groups. Our second prediction is that – based on prior work showing that activation of an identity leads people to respond more quickly to statements pertaining to that identity (Brewer and Gardner 1996; Wheeler and Fiske 2005) – signing causes individuals to take less time to answer the questions regarding the group they had selected.

Method

Participants. A total of 118 undergraduate students at the University of Alberta completed a series of studies for partial course credit.

Design. A 2 (handwriting task: sign, print name) × 2 (type of social group: in-group, out-group) between-subjects design was used.

Procedure. The study was conducted in a university research laboratory. Participants were randomly assigned to one of the four conditions. Seated in private cubicles, they first completed the handwriting task – i.e., they either signed or printed their name once on a blank sheet of paper (ostensibly for an unrelated study about handwriting). They were then asked to turn to the computer in their cubicle and follow the instructions provided on the screen (based on Berger and Heath 2007), which read: "In the text box below, please type in the name of a social group that you like and consider yourself quite similar to or belong to (dissimilar from or do not belong to). This group should be a tightly knit group, consisting of individuals who are very similar to one another." After that, participants were asked a series of questions about the social group they had selected. They rated how strongly they identify with that group (1 = very little, 7 = a great deal), how much they like the people in the group (1 = not at all, 7 = a great deal), and how similar they believe they are to the members of the group (1 = extremely dissimilar, 7 = extremely similar).

Results

Responses to the three questions were analyzed with 2 (handwriting task: print vs. sign name) × 2 (type of social group: in-group vs. out-group) ANOVAs. As expected, participants identified more closely with in-groups than with out-groups ($M_{in} = 8.1$, $M_{out} = 4.1$; $F(1,114) = 138.0$, $p < .001$), and they felt more similar to members of in-groups than to members of out-groups ($M_{in} = 7.7$, $M_{out} = 4.0$; $F(1,114) = 131.4$, $p < .001$). This indicates that our manipulation of social group type was effective.

An examination of how strongly participants identified with the social group reveals a significant handwriting task × social group type interaction ($F(1,116) = 4.6$, $p < .05$; see figure 4). Planned contrasts indicate that, as predicted, participants who had signed their name

identified significantly more with in-groups (M_{in_sign}= 8.4, M_{in_print} = 7.6; $F(1,62) = 3.0$, $p < .05$, one-tailed) and marginally less with out-groups (M_{out_sign} = 3.5, M_{out_print} = 4.4; $F(1,54) = 2.1$, $p = .07$, one-tailed) than those who had printed their name.

By contrast, whether participants had signed or printed their name does not moderate how similar they believed they were to the members of the group (handwriting task × social group type interaction: $p = .32$), nor was there a main effect of handwriting task on similarity ($p = .29$). Participants liked in-group members more than out-group members (M_{in} = 8.2, M_{out} = 6.4; $F(1,114) = 28.8$, $p < .001$), as expected, but the handwriting task does not moderate how much they liked the members of the group ($p = .24$). A main effect of handwriting task reveals that participants who had signed their name liked members of both types of social groups slightly more than did those who had printed their name (M_{sign} = 7.7, M_{print} = 7.0; $F(1,114) = 4.0$, $p < .05$). This pattern of results is consistent with our hypothesis that signing activates one's identification with the afforded social group, and it suggests that signing does not affect one's perceived similarity to that group.

Next, we examine the (log-transformed) total amount of time it took participants to respond to the three questions about the social group they had selected with an ANOVA using the same set of independent variables. A marginally significant main effect of handwriting task indicates that, as predicted, participants who had signed responded more quickly than those who had printed their name (M_{sign} = 27.5 seconds, M_{print} = 30.9 seconds; $F(1,114) = 2.4$, $p = .06$, one-tailed). A main effect of social group type also emerges (M_{in} = 27.7 seconds, M_{out} = 31.1 seconds; $F(1,114) = 3.5$, $p < .05$), which is consistent with prior work showing that people respond more quickly to statements about in-groups than to statements about out-groups (Pratto and Shih 2000). Critically, the handwriting task × social group type interaction is not significant

(p = .24), suggesting that – in line with our theory – signing activated the relevant aspect of participants' self-identity in both the in-group and the out-group condition.

Discussion

The results of study 3 support our theoretical account that signing one's name acts as a general self-identity prime. Signing caused people to identify even more closely with groups to which they belong, and even less closely with groups to which they do not belong. Moreover, participants who had signed their name responded more quickly to statements about the afforded social identity, which provides strong process evidence that signing activates the relevant aspect of one's self-identity.

STUDY 4

This study examines the effect of signing on product choices in situations that afford a social identity, and it provides an opportunity to obtain further evidence on the mental process implied by our theoretical account of the signature effect – identity activation. We used an identity-signaling paradigm adapted from Berger and Heath (2007) requiring participants to make choices in 19 different preference domains that vary in the extent to which they are relevant to signaling one's social identity. As in study 3, some participants were asked to name a group to which they belong (in-group), whereas others were asked to name a group to which they do not belong (out-group). For each of the 19 domains, participants were asked to indicate which of three available options they would choose, having been provided with information about the preferences of the members of the in- or out-group they had named. The three options varied in terms of how popular they were with the members of that specific social group. Choice

of the most popular option indicated conformity to the social group, whereas choice of the least popular option indicated divergence from it (see Berger and Heath 2007).

We have three predictions for this study. First, consistent with our overall hypothesis that signing promotes behavior that is congruent with the relevant aspect of one's self-identity, we predict that signing causes consumers to make choices that are more congruent with the afforded social group – participants who have signed their name should conform more with in-groups and diverge more from out-groups. Second, in line with our hypothesis that providing a signature activates one's identification with the afforded social group, we predict that signing has a stronger influence on choice in preference domains that are more relevant to signaling one's identity to others (e.g., music genre) than in domains that are not as relevant in this regard (e.g., bike light).

Our third prediction for this study pertains to decision time. The choices that participants were able to make can be classified as either identity-congruent (conforming with an in-group or diverging from an out-group) or identity-*in*congruent (diverging from an in-group or conforming with an out-group). In general, identity-incongruent choices tend to reflect greater conflict than identity-congruent choices. We predict that activation of one's identification with the afforded social group (caused by signing one's name) amplifies the conflict associated with making choices that are identity-incongruent (and reduces the conflict associated with making identity-congruent choices). In line with prior work showing that the amount of time individuals take to make a choice is an indicator of how much conflict the decision involves (Busemeyer and Townsend 1993; Diederich 2003; Tyebjee 1979), we predict that signing causes decision times to be longer for identity-incongruent than for identity-congruent choices.

Method

Participants. A total of 143 undergraduate students at the University of Alberta completed a series of studies for partial course credit.

Design. A 2 (handwriting task: sign, print name) × 2 (type of social group: in-group, out-group) × 19 (preference domain) mixed design was used, with preference domain being manipulated within-subject and the two other factors being manipulated between-subjects.

Procedure. The study was conducted in a university research laboratory. Participants were seated in private cubicles, and they were randomly assigned to one of the four between-subjects conditions. The study involved three stages. In the first stage, participants completed a handwriting task identical to that used in study 3 – either signing or printing their name once – and then turned to the computer in their cubicle, where they were asked to enter the name of an in-group or out-group (depending on which condition they had been assigned to). The remainder of the study was computer-based.

In the second stage, participants chose one of three options in each of the 19 preference domains. The order in which these domains were presented was determined at random for each participant. For each domain, the following instructions were provided: "Imagine that we asked the members of the group you identified, {name of group}, to choose one of three {preference domain}. The figure below represents the proportion of group members that chose each option." This statement was accompanied by a pie graph that indicated that 65% of the members of the group had chosen option A, 25% had chosen option B, and 10% had chosen option C. Below the pie graph, the following question appeared: "Which {preference domain} would you choose?" Participants indicated their choice by clicking one of three response buttons (labeled "Option A", "Option B", and "Option C").

Finally, in the third stage, participants were asked a series of questions about the social group they had selected. They rated how strongly they identify with that group (1 = very little, 7 = a great deal), how much they like the people in the group (1 = not at all, 7 = a great deal), and how similar they believe they are to the members of the group (1 = extremely dissimilar, 7 = extremely similar).

Results

Preliminary Analyses. As expected, participants identified more closely with in-groups than with out-groups (M_{in} = 7.4, M_{out} = 4.8; $F(1,139) = 52.3$, $p < .001$), and they felt more similar to members of in-groups than to members of out-groups (M_{in} = 7.1, M_{out} = 4.8; $F(1,139) = 63.6$, $p < .001$). This indicates that our manipulation of social group type was effective. On average, participants liked members of out-groups (M_{out} = 7.1 out of 10), although they did like members of in-groups slightly more (M_{in} = 8.1; $F(1,139) = 14.5$, $p < .001$). Unexpectedly, handwriting task had a main effect on how closely participants identified with the social group (M_{print} = 6.7, M_{sign} = 5.9; $F(1,139) = 5.27$, $p = .02$) and on how similar they felt to members of the social group (M_{print} = 6.4, M_{sign} = 5.8; $F(1,139) = 66.3$, $p = .02$), but not on how much participants liked group members (M_{print} = 7.7, M_{sign} = 7.6; $p = .66$). Critically, the handwriting task × social group type interaction was not significant for any of these variables (strength of identification: $p = .14$; similarity: $p = .30$; liking: $p = .71$). This pattern of results differs from that observed in study 3, which is not surprising given that these measures were taken after participants had made choices in 19 preference domains.

Hypothesis Tests. Our first two predictions were that signing would lead participants to make more identity-congruent choices, and that this effect would be greater in domains that are more relevant to signaling one's identity to others. To test these predictions, we first constructed

an identity-relevance score for each preference domain based on the results of Berger and Heath's study 2, such that the least identity-relevant domain was assigned a value of 1 and the most identity-relevant one was given a value of 19 (see appendix B). We then performed a mixed-effects logistic regression with choice of option C – indicating divergence – as the dependent variable and with handwriting task (sign vs. print name), type of social group (in-group vs. out-group), the identity-relevance score of the preference domain, and all possible interactions as independent variables, along with a random effect for participant. A main effect of identity-relevance ($\beta = 0.08$, $p < .001$) indicates that, overall, the inclination to diverge was greater in preference domains that are relevant to signaling one's identity to others, as expected. More importantly, this analysis reveals a significant three-way interaction ($\beta = 0.09$, $p < .05$). To shed light on the nature of this three-way interaction, we examine the handwriting task × social group type interaction separately at the highest and the lowest levels of identity-relevance. As predicted, the handwriting task × social group type interaction is significant when identity-relevance is highest ($\beta = 1.40$, $p < .01$), but not when identity-relevance is lowest ($p = .74$). Planned contrasts (at the highest level of identity-relevance) reveal that, in line with our theory, signing caused participants to diverge more from out-groups ($\beta = 0.74$, $p < .05$) and diverge less from in-groups ($\beta = -0.65$, $p < .05$) in domains that are relevant to signaling one's identity.

For choice of option A (indicating conformity), a similar mixed-effects logistic regression reveals a main effect of identity-relevance ($\beta = -0.16$, $p < .001$) indicating that, as expected, the inclination to conform was lower in preference domains that are relevant to signaling one's identity to others. More importantly, a marginally significant three-way interaction ($\beta = 0.02$, $p = .07$) emerges. Consistent with our theoretical account, the handwriting task × social group type interaction is significant when identity-relevance is highest ($\beta = 0.41$, $p < .001$), but not

when it is lowest ($p = .32$). Planned contrasts (at the highest level of identity-relevance) reveal that, as predicted, signing caused participants to conform more with in-groups ($\beta = 0.84$, $p < .01$) and conform less with out-groups ($\beta = -0.82$, $p < .05$) in identity-relevant domains.

Figure 5 illustrates the nature of the interplay between handwriting task, social group type, and identity-relevance of the preference domain. We split the preference domains into two categories based on their degree of identity-relevance. Specifically, the ten domains with the highest identity-relevance scores were categorized as "More Identity-Relevant" (Favorite Actor, Car Brand, Car Model, Hairstyle, Jacket, Music Artist, Music CD, Music Genre, Sitcom, Sunglasses), and the remaining domains were categorized as "Less Identity-Relevant" (Backpack, Bike Light, Detergent, Dinner Entrée, Dish Soap, Power Tools, Sofa, Stereo, Toothpaste). In the more identity-relevant preference domains, signing caused greater divergence from out-groups ($P_{sign\_out} = 35\%$, $P_{print\_out} = 23\%$) and less divergence from in-groups ($P_{sign\_in} = 20\%$, $P_{print\_in} = 28\%$), and it caused greater conformity to in-groups ($P_{sign\_in} = 49\%$, $P_{print\_in} = 34\%$) and less conformity to out-groups ($P_{sign\_out} = 22\%$, $P_{print\_out} = 34\%$). By contrast, signing had no effect in the domains that are less relevant to signaling one's identity.

Our third prediction was that signing would cause decision times to be longer for identity-incongruent choices (divergence from an in-group or conformity with an out-group) than for identity-congruent choices (conformity with an in-group or divergence from an out-group). We examined participants' (log-transformed) decision times using a mixed-effects model with handwriting task (sign vs. print name), whether the chosen option was identity-congruent or identity-incongruent, and their interaction as predictor variables, along with a dummy variable for preference domain and a random effect for participant. This analysis reveals a significant interaction effect ($F(2,2554) = 9.5$, $p < .01$), the nature of which provides strong support for our

theoretical account (see figure 6). Signing caused participants to take more time to make identity-incongruent than identity-congruent choices (M_{sign_incon} = 5.14 seconds, M_{sign_con} = 4.23 seconds; $p < .01$), whereas there was no difference in decision times among those who had printed their name (M_{print_incon} = 4.75 seconds, M_{print_con} = 4.74 seconds; $p = .87$). Thus, consistent with our theoretical account, signing caused decision times to be longer when participants made choices that were in conflict with, rather than congruent with, the afforded aspect of their self-identity.

Discussion

The findings of study 4 provide strong evidence that signing one's name acts as a general self-identity prime. Consistent with our hypothesis, signing their name had a polarizing effect on participants' choices in a setting where a particular social identity was afforded – it caused them to diverge more from an out-group and conform more with an in-group, and this effect was stronger in domains that are more relevant to signaling one's identity to others. Finally, an analysis of decision times supports our proposed mental mechanism – namely, that the signature effect is driven by the activation of the relevant aspect of one's self-identity.

GENERAL DISCUSSION

Consumers sign their name in many everyday situations, and they do so for a wide range of purposes – such as to identify themselves, to authorize payment, to enter into agreements, and to commit themselves to future obligations. Yet, despite the pervasiveness of handwritten signatures in human economic life, prior research has provided little insight into whether signing one's name influences subsequent behavior. We have introduced the hypothesis that signing one's name acts as a general self-identity prime, thus making it more likely that situational

affordances activate the relevant aspect of one's self-identity. Converging evidence from four studies – examining various consumption domains and involving different aspects of a consumer's self-identity – demonstrates that signing promotes behavior congruent with the specific aspect of one's self-identity that is afforded by the situation.

The present research makes several key contributions to our understanding of consumer behavior. It is the first to demonstrate that signing one's name influences subsequent behavior in a predictable manner, and thus enhances our understanding of the significance of the act of signing. This work also makes a novel contribution to the priming literature – which has focused on the role of cues in the activation of particular constructs or identities (e.g., Berger and Fitzsimons 2008; Kay et al. 2004; North, Hargreaves, and McKendrick 1997) – by showing that the act of producing one's signature affects one's subsequent responsiveness to identity-relevant cues.

This article adds to prior work that has explored the general priming of one's self-concept (such as through exposure to self-referent words or by having one respond to personality test items; see Dijksterhuis and van Knippenberg 2000; Hamilton and Shuminsky 1990; Smeesters et al. 2009) in that it identifies a simple intervention – signing one's name – that acts as a general self-identity prime. In addition, it extends recent work suggesting that a given intervention can produce different effects on behavior (Cesario et al. 2010; Wheeler and Berger 2007) by demonstrating that an identity-relevant action such as producing one's signature can have contrasting effects on one's behavior depending on which aspect of one's self-identity is afforded in a particular situation.

The findings presented here provide a novel perspective on prior research that examines how signing a document influences subsequent behavior. Because people are more likely to

engage in a behavior once they have signed a document that indicates their intention to do so (Anker and Crowley 1981; Mazar et al. 2008; McCabe and Trevino 1997; Rogers et al. 1988; Stevens et al. 2002; Ureda 1980; Williams et al. 2005), one might assume that merely signing one's name implies a commitment (Cialdini 2001; Schwarzwald, Bizman, and Raz 1983). However, people often sign documents for purposes that are not associated with commitment – they sign to authorize an action (e.g., a professor signing to approve a dissertation), to identify themselves (e.g., on a passport), or to affirm their understanding of a document's contents (e.g., an insurance form). Thus, although a signature does not necessarily imply commitment, it does always represent one's identity. For instance, our finding that signing causes people to spend *less* time and effort when shopping in a product domain that they do not identify closely with (studies 1 and 2) is consistent with our theoretical account, but not with one based on commitment.

This article's key finding – that providing a signature predictably influences subsequent behavior – suggests novel interventions that sellers could use in order to influence consumer behavior. For instance, a retailer might ask shoppers to their sign their name after completing a survey, to enter a prize draw, or to enroll in a loyalty program, since doing so should lead consumers who identify closely with the store's products to subsequently be more engaged. However, such signature interventions should be used cautiously as signing tends to reduce engagement in consumers who lack such identification. For instance, a sporting goods store specializing in high-end running gear could benefit from having avid runners sign, but might be better off not soliciting signatures from average consumers shopping for a pair of sneakers.

The present work suggests several directions for future research. First, although our results highlight the robustness of the signature effect – it holds for different aspects of one's

self-identity, it can be obtained both in the lab and in field settings, and a single signature is sufficient to change behavior – future work should aim to identify boundary conditions for the effect. One possible condition is the presence of any factor that inhibits consumers' opportunity to properly produce their signature. In line with recent work indicating that writing with one's non-dominant hand can shake one's self-view confidence (Gao, Wheeler, and Shiv 2009), we expect that a disruption of the process of signing – such as by forcing people to sign in a constrained space (e.g., on a small slip of paper) or with utensils that prevent them from precisely replicating their signature (e.g., on an electronic signature pad) – should diminish the signature effect (and perhaps even produce contrasting effects on behavior, such as causing consumers to subsequently choose self-view bolstering products to restore their confidence).

Second, although our results indicate that signing leads to the activation of the specific aspect of one's self-identity that is hypothesized to be afforded by the situation, our theory does not require that only a single aspect is activated – merely that the relevant aspect is activated more strongly than others. Real-world situations (particularly complex ones) can simultaneously afford multiple, potentially conflicting aspects of one's self-identity (Hong et al. 2003; Shih, Pittinsky, and Ambady, 1999), and this may lead to the joint activation of different aspects. Enhancing our understanding of what happens when multiple aspects of one's identity are simultaneously afforded is an important area for further research.

Finally, it would be worth examining how providing a signature within a consumption context affects behavior. One limitation of the present work is that participants signed on blank pieces of paper in task that was ostensibly unrelated to consumption. Although this ensured high internal validity of our findings by clearly isolating the act of signing, it did so at the expense of external validity. Future research should investigate how signing one's name might interact with

the nature of the document being signed. For example, is the signature effect diminished or enhanced when consumers sign important documents such as mortgage agreements? Similarly, does the purpose of the signature – e.g., verifying that a course of action has been completed versus committing to a future course of action – moderate its effect on subsequent behavior? Because consumers sign (or can be asked to do so) in many consumption contexts, it is important to develop a deeper understanding of how producing one's signature influences behavior.

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APPENDIX A. PRODUCT DESCRIPTIONS (STUDY 1)

Product Categories

Digital Cameras			
Brand	Nikon	Olympus	Sony
Model	P80	SP 570	DSC-H50
Price	$400	$400	$400
35mm Equivalent Zoom	486 mm	520 mm	465 mm
Viewfinder Type	Electronic	Optical	Optical
Digital Sensor Size	10.0 MP	10.0 MP	10.0 MP
Digital Zoom	4.0 X	5.0 X	2.0 X
Effective Size of Digital Sensor	10.7 MP	10.0 MP	9.1 MP
Flash Range	9 meters	7 meters	18 meters
Focus Range	40 cm	16 cm	120 cm
Internal Memory	52 MB	45 MB	15 MB
LCD Monitor Size	2.7 inches	2.7 inches	3 inches
Aperture Range	f/2.8 – f/45	f/2.8 – f/45	f/2.7 – f/8.0
Optical Zoom	18 X	20 X	15 X
Shutter Speed	1 / 4000 sec	1 / 2000 sec	1 / 4000 sec
Weight	365 grams	131 grams	554 grams
Warranty	2 Years Parts & Labor	1 Year Parts & Labor	1 Year Parts & Labor
Camera Dimensions	11.0 (W) x 7.9 (H) x 7.8 (D) cm	11.7 (W) x 7.9 (H) x 7.9 (D) cm	11.6 (W) x 8.1 (H) x 8.6 (D) cm

Dishwashers			
Brand	Frigidaire	Maytag	Whirlpool
Model	GLD 225	MDB 560	DU 1055
Price	$500	$500	$500
Filtration System	100% Filtration	Micro-Fine Plus	Automatic Purge Filtration
Delay Start Options	2, 4, 6 hrs	1-6 hrs	2-4 hrs
Drying Options	Heat, No Dry	Heated Dry	Heated Dry
EnerGuide Rating	343 KWh / Year	346 KWh / Year	370 KWh / Year
Interior Finish	Dura Life	Plastic	Plastic
Number of Cycles	4	4	4
Product Dimensions	60.6 (W) x 84.7 (H) x 61.3 (D) cm	60.6 (W) x 87.6 (H) x 60.6 (D) cm	60.6 (W) x 87.6 (H) x 62.2 (D) cm
Warranty	1 Year Parts & Labor	1 Year Limited	1 Year Limited
Weight	33 kg	42 kg	42 kg
Sensors	Smart Soil	Precision Clean & Turbidity	Auto Soil Sensor
Short (Econo) Wash	Yes	No	No
Wash System	Precision Wash	Jetclean II Wash System	Sheer Clean Wash
Wash Levels	5	3	5
Rack Material	Nylon	Vinyl	PVC
Lock Type	Squeeze	Pull	Latch Engage

APPENDIX B. PREFERENCE DOMAINS (STUDY 4)

Domain	Identity-Relevance Score
Bike Light	1
Dish Soap	2
Detergent	3
Toothpaste	4
Power Tools	5
Stereo	6
Sofa	7
Backpack	8
Dinner Entrée	9
Sunglasses	10
Car Model	11
Favorite Actor	12
Car Brand	13
Jacket	14
Sitcom	15
Favorite CD	16
Music Artist	17
Hairstyle	18
Music Genre	19

NOTE: BASED ON BERGER AND HEATH (2007, STUDY 2)

FIGURE 1. EXAMPLE OF SELF-IDENTITY

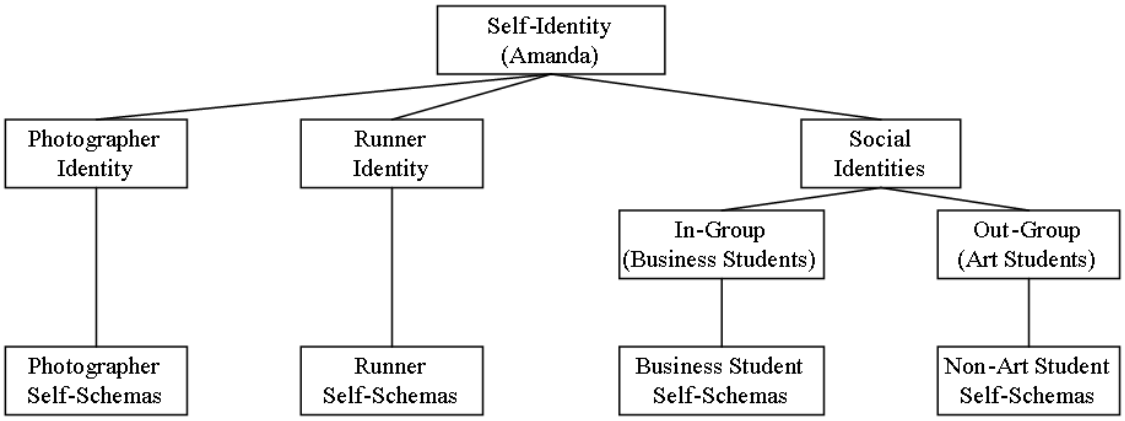


FIGURE 2.
STUDY 1: AMOUNT OF PRODUCT INFORMATION INSPECTED AS A FUNCTION OF PRODUCT CATEGORY AND HANDWRITING TASK

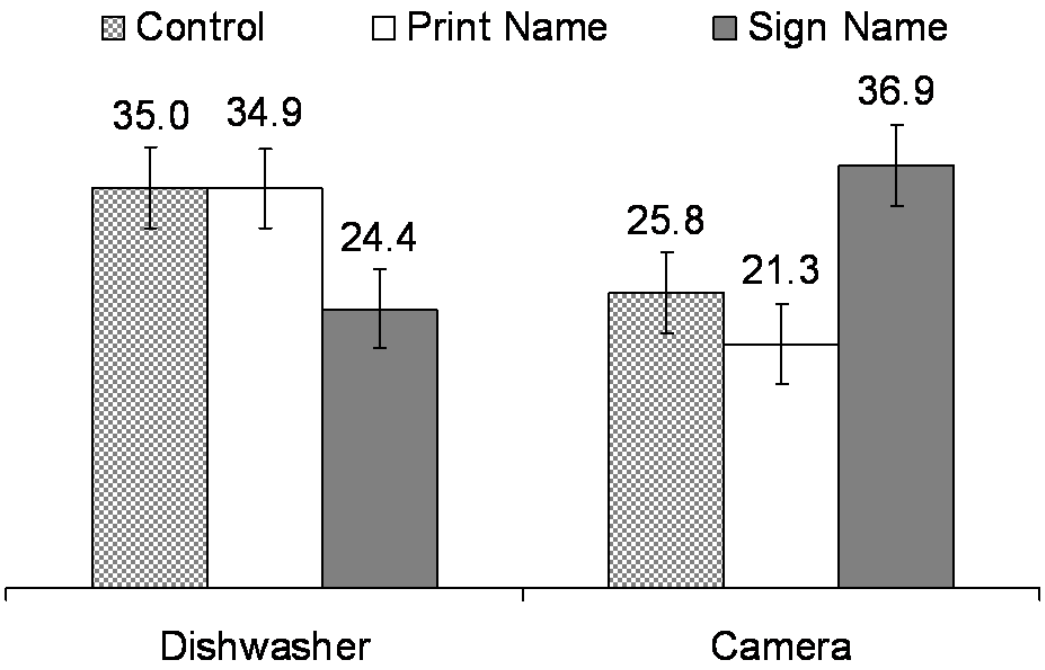
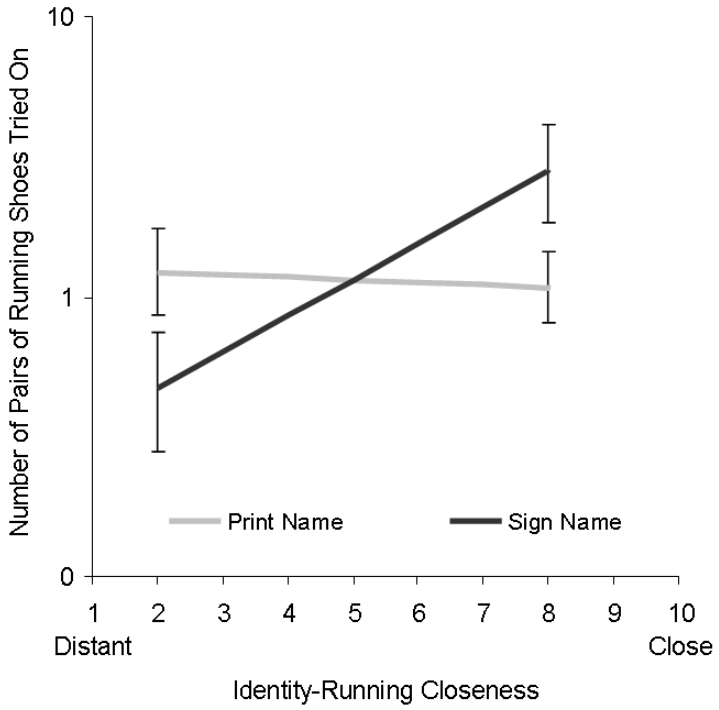


FIGURE 3.
STUDY 2: NUMBER OF PAIRS OF RUNNING SHOES TRIED ON AS A FUNCTION OF IDENTITY-RUNNING CLOSENESS AND HANDWRITING TASK



Note. – This figure represents fitted logistic regression lines.

FIGURE 4.
STUDY 3: IDENTIFICATION WITH A SOCIAL GROUP AS A FUNCTION OF SOCIAL GROUP TYPE AND HANDWRITING TASK

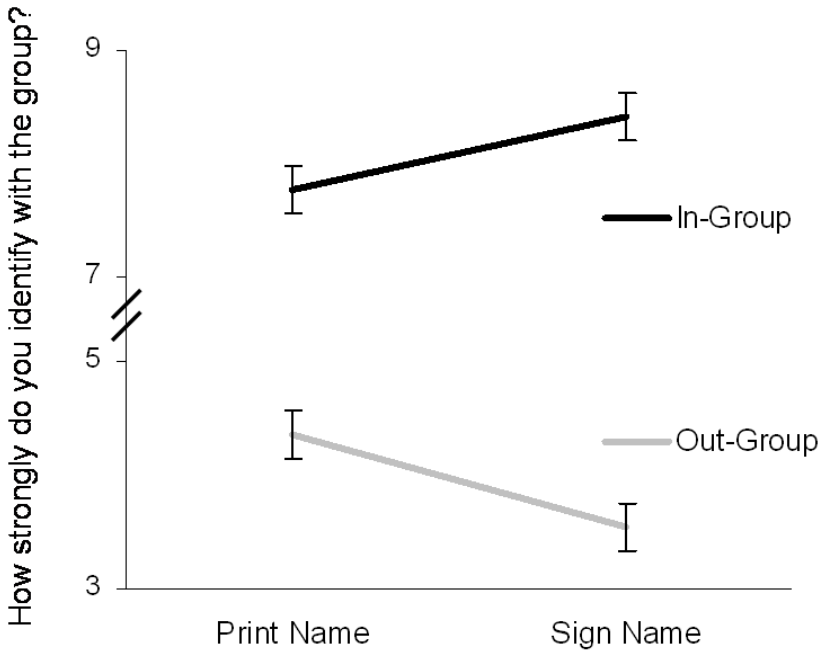


FIGURE 5.
STUDY 4: CONFORMITY AND DIVERGENCE AS A FUNCTION OF HANDWRITING TASK, SOCIAL GROUP TYPE, AND RELEVANCE OF THE PREFERENCE DOMAIN TO SIGNALING ONE'S IDENTITY

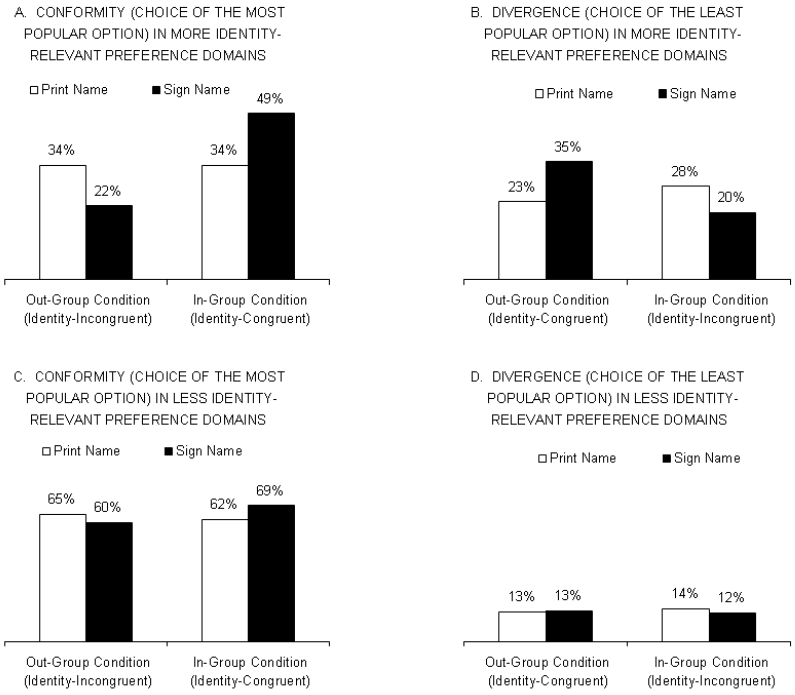
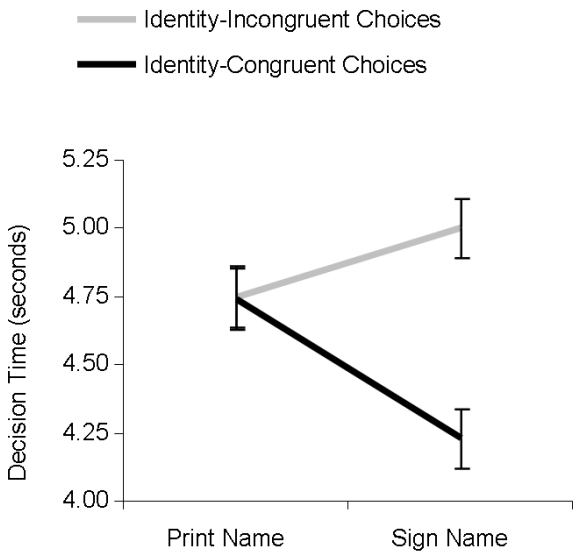


FIGURE 6.
STUDY 4: DECISION TIME AS A FUNCTION OF HANDWRITING TASK AND WHETHER CHOICE IS IDENTITY-INCONGRUENT OR IDENTITY-CONGRUENT



CHAPTER 3: THE EFFECT OF A GENERAL SELF-CONCEPT PRIME ON MATH PERFORMANCE

ABSTRACT

Results from four studies show that a general self-concept prime – signing one's name – can widen the gender gap in math performance, and that this effect emerges in a population in which females (as compared to males) have lesser talent self-perceptions. Signing their name leads introductory-level female undergraduate students to perform worse at solving difficult advanced-level math problems (study 1), but does not have the same effect on the performance of more senior female students (study 2) or quantitatively skilled individuals (accounting students; study 3). Although females exhibit more negative attitudes toward math (study 4), signing does not differentially activate those attitudes, but rather widens the gender gap by strengthening the relationship between self-perceived talent and performance. Signing worsens the performance of individuals who perceive themselves as lacking domain-specific talent, but enhances the performance of those who see themselves as highly talented. Theoretical and practical implications are discussed.

There is widespread concern about the fact that females are underrepresented in math-intensive programs and careers (Betz 1997; Ceci & Williams 2010; Halpern et al. 2007), despite the absence of gender differences in math performance through early high school years (Feingold 1988; Hyde et al. 2008; Steele 2003). This so-called *gender gap* is often attributed to the stereotype that females are less capable than males in math and science (Gonzales, Blanton, & Williams 2002; Hyde & Mertz 2008; Nosek, Banaji, & Greenwald 2002). Consequently, behavioral research has focused on identifying interventions that are believed to prime the female stereotype, and documenting how those interventions affect females' math performance. Recent work indicates, for instance, that females tend to perform worse at math if they internalize the negative stereotype about females' math abilities (Bonnot & Croziet 2007; Kiefer & Sekaquaptewa 2007), believe that a math test can affirm the stereotype (Brown & Josephs 1999), experience self-objectification (Fredrickson et al. 1998), or encounter threatening situations that perpetuate the stereotype (Bielock et al. 2010; Josephs et al. 2003; Inzlicht & Ben-Zeev 2004; Keller 2002; Schmader et al. 2007).

What is less clear is whether females consider the negative stereotype about their math ability to be an aspect of their self-concept, or if the negative stereotype is spontaneously activated due to the nature of the interventions employed. Although priming their gender identity can lead females to perform worse at solving math problems (Shih et al., 2002) and stereotype threats even affect females with highly advanced levels of math ability (Murphy, Steele, & Gross 2007), males also perform worse when primed with the female stereotype (Aronson et al. 1999), and research has shown that priming a stereotype produces stereotype-congruent behavior in individuals for whom the stereotype is not part of their self-concept (Bargh, Chen, & Burrows 1996; Bry, Follenfant, & Meyer 2008; DeMaree, Wheeler, & Petty

2005b; Shih et al. 2002). Consequently, research that shows that priming the gender identity of females hinders their math performance does not provide conclusive evidence that the negative stereotype is part of the females' self-concept.

An alternative account for the gender gap has recently emerged that is based on natural gender differences in the distribution of mathematical abilities. Although there is no gender difference in mean math ability across the general population, the distribution of ability differs across gender, with greater variance among males as compared to females (Ceci & Williams 2010). This difference in the distribution of ability helps to explain why a gender gap is absent through early high school years when measures of math performance represent the entire population (Hyde et al. 2008), yet emerges at advanced levels of math education when measures of math performance reflect only the upper tail of each distribution, and the longer upper tail of the male distribution produces a gender difference in mean math performance (Ceci & Williams 2010). Consequently, among highly capable individuals – such as those in math-intensive fields – a gender gap in math performance may emerge even though females in that field do not perceive themselves to lack ability in math.

To examine whether females consider the negative stereotype about their math ability to be an aspect of their self-concept, we investigate how a general self-concept prime (signing one's name; Kettle & Häubl 2011) influences math performance. In contrast to priming a particular social identity or stereotype – which activates thoughts associated with the primed identity or stereotype (Bargh, Chen, & Burrows 1996; Mussweiler 2006) – a general self-concept prime does not differentially activate a particular social identity, stereotype, or construct. Rather, a general self-concept prime activates the aspect of one's self-concept that is afforded by the present situation (Kettle & Häubl 2011). If the stereotype about their gender's math ability is a

relevant aspect of their self-concept, then signing their name should induce females to perform worse at math.

We have two key predictions about the effect of a general self-concept prime on math performance. Our first prediction is based on the fact that individuals in any population will vary in terms of how talented they perceive themselves to be in a particular domain. Given that a general self-concept prime activates the aspect of one's self-concept that is relevant in the present situation (Kettle & Häubl 2011), and that one's self-perceived level of math talent is the relevant aspect in the context of math performance, we predict that a general self-concept prime will strengthen the effect of self-perceived talent on performance.

Our second prediction is based on the premise that females with advanced math skills do not perceive themselves to lack in talent in that domain. Consistent with prior work indicating that a gender gap emerges among individuals with advanced math skills even though females in that field do not perceive themselves to lack ability in math, we predict that a general self-concept prime will not hinder the performance of females with advanced levels of ability.

We present evidence from four studies that examine how a general self-concept prime influences math performance. In line with our theorizing, the results of all four studies show that the general priming of one's self-concept reliably strengthens the effect of self-perceived talent on performance, and that the negative stereotype about females' math ability is not an aspect of the self-concept of females in all populations. First, we show that a general self-concept prime (signing one's name) induces female undergraduate students in an introductory-level course to perform worse at solving difficult advanced-level math problems (study 1), thus broadening the gender gap in that population. We demonstrate that this effect does not emerge in a population of senior undergraduate and graduate students in which there is no difference in the self-

perceived talent of females as compared to males (study 2), nor does it appear in a population of highly skilled math students (senior accounting undergraduates; study 3), despite the fact that in both populations signing their name strengthens the relationship between self-perceived talent and performance. Finally, we demonstrate that it is the activation of the self-concept, rather than one's attitudes about math, that causes a general self-concept prime to predictably influence performance (study 4), and that signing can also widen the gender gap by improving the performance of males rather than hindering the performance of females.

Study 1

In study 1 we investigate how a general self-concept prime – signing one's name (Kettle & Häubl 2011) – influences the performance of undergraduate students enrolled in an introductory-level business course at solving quantitative problems taken from the Graduate Management Aptitude Test (GMAT). Consistent with prior evidence indicating that female undergraduate students in introductory-level courses perceive themselves as lacking talent in math (Brown & Josephs 1999; Johns et al. 2008), we predicted that a general self-concept prime would broaden the existing gender gap by inducing females to perform worse.

Method

Participants. Participants were 113 introductory business students (44 female, 69 male) who volunteered for extra credit.

Design. A single factor (handwriting manipulation: sign name, print name) between-subjects design was used.

Handwriting Manipulation. Each participant received two sheets of paper (stapled together) and a pen. The top sheet contained a set of instructions, including a cover story about

the researchers' interest in handwriting. The second sheet contained the instructions "Please sign (print) your name on the line below", followed by a single blank line.

Procedure. Participants were seated in private cubicles. Assignment to condition was random. First, participants completed the handwriting manipulation. Next, participants were presented with a second, independent study about math. The focal task was to solve multiple-choice quantitative GMAT problems, each of which had five options labeled "a" through "e". Participants had up to 10 minutes to solve up to 10 problems, which were randomly drawn without replacement from a set of 58 problems taken from a practice GMAT exam (see Appendix A). Finally, participants responded to a series of questions about themselves and the task, including "How talented are you at solving math problems" (1 = Not Talented; 10 = Very Talented), "How much did you enjoy solving the math problems" (1 = Not At All; 10 = Very Much), "How motivated were you to solve the math problems" (1 = Not At All; 10 = Very Much), and "How difficult did you find the math problems" (1 = Not At All Difficult; 10 = Very Difficult).

Results

Preliminary Analyses. On average, participants attempted to solve 8 math problems, and solved 3.3. Of the 113 participants, 51 attempted all 10 GMAT problems, and only 6 participants failed to solve a single problem. A poisson regression reveals that males and females did not differ in terms of the number of problems they attempted ($p = .48$), nor was this moderated by the handwriting manipulation ($p = .57$).

As compared to males, female participants felt significantly less talented ($M_{female} = 3.6$, $M_{male} = 4.1$, $p < .05$), found the problems more difficult ($M_{female} = 5.6$, $M_{male} = 4.8$, $p < .01$), were

less motivated (M_{female} = 2.4, M_{male} = 3.9, $p < .01$), and enjoyed the task significantly less (M_{female} = 1.8, M_{male} = 3.7, $p < .01$). These differences were not moderated by handwriting manipulation (ps > .12).

Hypothesis Tests. First, to examine the role of gender, we estimated a mixed-effects logistic regression – with the dependent variable being whether or not a problem was solved – on the following independent variables: handwriting manipulation, gender, their interaction, self-reported grade-point average (GPA) as a covariate, and crossed random effects for participant and math problem. A significant handwriting manipulation × gender interaction emerges (β = 0.75, $p < .05$). There is a gender gap in the control condition ($P_{male.print}$ = 42%, $P_{fem.print}$ = 31%, β = 0.60, p = .01), but it is significantly greater in the signature condition ($P_{male.print}$ = 47%, $P_{fem.print}$ = 22%, β = 1.35, $p < .001$). As expected, female participants who signed their name performed worse than females who printed their name ($P_{fem.print}$ = 31%, $P_{fem.sign}$ = 22%, β = -0.47, p = .05), but the handwriting manipulation did not affect males' performance ($P_{male.print}$ = 42%, $P_{male.sign}$ = 47%, β = 0.28, p = .12). Figure 1a illustrates the contrasting effect of the general self-concept prime on the performance of male and female students.

Second, to examine the role of self-perceived talent we conducted a similar mixed-effects logistic regression, replacing gender with our measure of self-perceived talent. A significant handwriting manipulation × talent interaction emerges (β = 0.14, $p < .05$; see figure 1b). Spotlight analyses (Aiken and West 1991) conducted at one standard deviation above and below the mean reveal that signing hindered the performance of participants at lower levels of self-perceived talent (β = -0.19, p = .07), but enhanced the performance of participants at higher levels of self-perceived talent (β = 0.24, p = .05). Similar regression analyses indicate that

performance was not influenced by the interaction of signing and motivation ($p = .11$), task enjoyment ($p = .66$), or perceived difficulty of the problems ($p = .79$).

Third, we conducted a similar mixed-effects logistic regression on handwriting manipulation, gender, self-perceived talent, and all interactions. The handwriting manipulation × gender × talent interaction was not significant ($p = .87$), indicating that the interplay of the general self-concept prime and self-perceived talent did not differ across males and females. Both the handwriting manipulation × talent interaction ($\beta = 0.11$, $p < .06$) and the handwriting manipulation × gender interaction ($\beta = 0.17$, $p < .08$) were marginally significant. Thus, although the general self-concept prime influenced performance by activating self-perceived talent, the difference in self-perceived talent does not fully account for the effect of signing one's name on the math performance of females as compared to males.

Discussion

The results of study 1 show that, as predicted, soliciting a signature can broaden the gender gap in math performance. By activating the relevant aspect of their self-concept (i.e., that they lack the talent to solve the problems), signing their name led female undergraduate students in an introductory-level course to perform worse at solving graduate-level math problems, but did not hinder the performance of males in the same course. Critically, the results suggest that, in addition to activating their self-perceived talent, signing also activated the negative stereotype about the math ability of females.

To explore this further, in study 2 we examine the performance of senior undergraduate and graduate students. If, as hypothesized, the general self-concept prime hinders the performance of females who view themselves as having poor math skills, then signing should not

lead to worse performance among a population of more senior university students. We predict that, if there is no gender gap in self-perceived talent, then a general self-concept prime will not broaden the gender gap in performance.

Study 2

The procedure was almost identical to study 1, except that: (a) participants in the control condition neither signed nor printed their name, and (b) a smaller set of 20 GMAT problems was used (see Appendix A: extremely difficult and extremely easy problems were removed from the larger set used in study 1).

Method

Participants. Participants were 110 senior undergraduate and graduate students (46 female, 64 male) who volunteered for a monetary reward.

Design. A single factor (signature: yes, no) between-subjects design was used.

Results

Preliminary Analyses. Participants attempted to solve an average of 8.8 math problems, and solved an average of 4.6. Of the 110 participants, 40 participants attempted all 10 GMAT problems, and only two failed to solve a single problem. A poisson regression reveals that males and females did not differ in terms of the number of problems they attempted ($p = .72$), nor was this moderated by the handwriting manipulation ($p = .46$).

There were no differences between male and female participants in self-perceived talent ($p = .20$), task enjoyment ($p = .32$), motivation ($p = .64$), or perceived difficult ($p = .34$), nor did any gender differences emerge as a function of the signature manipulation ($ps > .17$).

Hypothesis Tests. The methods of analysis were identical to study 1, with the dependent variable being whether or not a problem was solved. First, we examine the role of gender. A significant main effect for gender emerges (P_{female} = 46%, P_{male} = 55%, $p < .05$), as does a marginally significant effect for handwriting manipulation ($P_{control}$ = 47%, P_{sign} = 56%, $p = .06$); however, the signature × gender interaction is not significant ($p = .99$), indicating that the general self-concept prime did not differentially affect the performance of females as compared to males. Thus, although a gender gap emerges, signing their name marginally enhanced the performance of all participants, and thus did not broaden the gender gap (see figure 2a).

Second, we examine the role of self-perceived talent. A significant handwriting manipulation × talent interaction emerges ($\beta = 0.14$, $p < .05$; see figure 2b). Spotlight analyses reveal that signing did not hinder the performance of participants at lower levels of self-perceived talent ($p = .81$), but rather enhanced performance among participants at higher levels of self-perceived talent ($\beta = 0.79$, $p < .01$). Similar regressions reveal that performance was not influenced by the interaction of signing and motivation ($p = .42$), task enjoyment ($p = .76$), or perceived difficulty of the problems ($p = .40$).

Third, we conducted a similar mixed-effects logistic regression, with handwriting manipulation, gender, self-perceived talent, and all interactions. The signature × gender × talent interaction was not significant ($p = .89$), indicating that the interplay of self-perceived talent and the general self-concept prime did not differ across males and females. The signature × talent interaction was significant ($\beta = 0.11$, $p < .05$) but the signature × gender interaction ($p = .76$) was not significant. Thus, in contrast to the population examined in study 1, the general self-concept prime influenced performance by activating self-perceived talent, and there was no additional effect of signing on the math performance of females as compared to males.

Discussion

The results of study 2 provide convergent evidence for our account of the effect of a general self-concept prime on math performance. In a population of senior undergraduate and graduate students, females did not differ from males in their self-perceived level of talent, and signing their name did not differentially affect the performance of females as compared to males. In fact, signing their name enhanced the performance of both male and female participants. Critically, signing moderated the effect of self-perceived talent on performance.

There is an important unresolved question, however, that we address in study 3. What is the role of problem difficulty? It is possible that, due to their lack of seniority, the students who participated in study 1 perceived the GMAT problems to be beyond their ability, whereas the (more) senior students in study 2 did not. In study 3, we address this issue by using a within-subjects design with two types of quantitative problems that vary in difficulty. Using participants with advanced math skills – senior undergraduate accounting students – we assigned participants to both 5 GMAT problems and 5 quantitative problems from the Uniform Final Exam (UFE), a standardized exam that all Chartered Accountants must pass to receive their designation. We have two key predictions: first, based on our overall theory, we predict that signing their name will moderate the relationship between self-perceived talent and performance, but will not moderate the relationship between gender and performance. Second, in line with our proposal that signing activates one's self-concept, we predict that this effect will not be moderated by the difficulty of the problems.

Study 3

Method

Participants. Participants were 28 advanced-level accounting students (20 female, 8 male) who volunteered in exchange for a monetary reward.

Design. A mixed 2 (signature: required, not required) x 2 (problem type: GMAT, UFE) was used, with each factor manipulated on a within-subject basis.

Procedure. Participants signed up for two separate sessions scheduled a week apart. In the first session, participants were randomly assigned to a condition; in the second session, participants were assigned to the condition with the opposite levels of each factor, such that over the two sessions each participant signed their name once, and completed each set of questions (GMAT vs UFE) once.

Signature Manipulation. Participants in all conditions were required to print their name and their Student ID Number. Participants in the signature condition were also required to sign their name.

Quantitative GMAT and UFE Problems. Participants were independently randomly assigned 5 problems from a set of either 20 GMAT problems (see Appendix A) or 10 UFE problems (see Appendix B).

Results

Preliminary Analyses. Every participant attempted to solve all 5 problems in both sessions. On average, they solved 3.2 GMAT problems (64.8% success rate) and 1.5 UFE problems (30.2% success rate). There were no differences between male and female participants in self-perceived talent ($p = .56$), motivation ($p = .57$), task enjoyment ($p = .71$), or perceived

difficulty ($p = .32$), nor were any of these moderated by whether participants had signed their name (ps > .29), or by whether they attempted GMAT or UFE problems (ps > .33). Although participants were as motivated to solve UFE as compared to GMAT problems ($p = .24$), they found UFE problems to be significantly more difficult than GMAT problems ($M_{UFE} = 4.7$, $M_{GMAT} = 4.0$, $p < .05$), and they enjoyed the UFE problems significantly less ($M_{UFE} = 3.6$, $M_{GMAT} = 4.6$, $p < .05$), but neither of these differences were moderated by whether participants had signed their name (ps > .55).

Hypothesis Tests. First, to examine the role of gender we estimated a mixed-effects logistic regression – with the dependent variable being whether or not a problem was solved – on the following independent variables: signature manipulation, problem type, gender, all interactions, with random effects for each problem and participant. The three-way signature × problem type × gender interaction is not significant ($p = .97$), nor is the signature × gender interaction ($p = .25$), or the signature × problem type interaction ($p = .79$). As predicted, signing their name did not cause female participants to perform either better or worse ($P_{female.control} = 43\%$, $P_{female.sign} = 46\%$, $p = .91$), nor did it significantly enhance the performance of the male participants ($P_{male.control} = 51\%$, $P_{male.sign} = 63\%$, $p = .17$; see figure 3a).

Second, we examine the role of self-perceived talent. The three-way signature × problem type × talent interaction is not significant ($p = .63$), and the only significant two-way interaction to emerge is the signature × talent interaction ($\beta = 0.22$, $p < .05$). Spotlight analyses reveal that signing enhanced the performance of participants at higher levels of self-perceived talent ($\beta = 0.39$, $p < .05$), and marginally diminished the performance of participants at lower levels of self-perceived talent ($\beta = -0.29$, $p = .08$). Performance was not influenced by the interplay of signing and motivation ($p = .38$), task enjoyment ($p = .76$), or perceived difficulty of the

problems (p = .61). Figure 3b illustrates the moderating effect of the general self-concept prime on the relationship between self-perceived talent and performance.

Third, we conducted a similar mixed-effects logistic regression, with signature, gender, self-perceived talent, and all interactions. Although the signature × talent interaction was significant (β = 0.26, p < .05), the signature × gender × talent interaction was not significant (p = .99), indicating that the interplay of the general self-concept prime and self-perceived talent did not differ across males and females. The signature × talent interaction was significant (β = 0.26, p < .05) but the signature × gender interaction (p = .83) was not. Thus, consistent with the population examined in study 1, the general self-concept prime influenced performance by activating self-perceived talent, and there was no additional effect of signing on the math performance of females as compared to males.

Discussion

In study 3, we show that a general self-concept prime does not affect the math performance of female undergraduate accounting students (whose self-perceived talent did not differ from their male counterparts). Critically, signing moderated the effect of self-perceived talent on performance, and this interaction was not moderated by the difficulty of the math problems. These results are consistent with our account that a general self-concept prime influences performance by activating the relevant aspect of one's self-concept.

An alternative explanation for these results is that signing activates one's attitudes toward the focal task, and that the heightened influence of these attitudes affects task performance (Bargh, Chen, and Burrows 1996; DeMarree, Wheeler, and Petty 2005). We investigate this alternative account in study 4 by using a sequential evaluative priming paradigm (Ferguson and

Bargh 2004) to determine whether signing differentially activates negative versus positive thoughts in females as compared to males and, if so, whether this affects performance in a manner consistent with their gender.

Study 4

Study 4 was designed to examine the role of attitudes toward math in the prime-to-performance effect of a general self-concept prime. Participants completed an evaluation task (Ferguson and Bargh 2004) that was designed to determine whether signing differentially activates negative versus positive thoughts. In addition to the general self-concept prime, we also manipulated whether or not participants were given a preview of a sample GMAT math problem prior to completing the evaluation task. This preview manipulation was designed to contrast a construct prime – which has been shown to increase the accessibility of construct-relevant thoughts and attitudes (Anderson, Benjamin, & Bartholow 1998) – with a general self-concept prime, which has been shown to activate the relevant aspect of one's self-concept.

We have three key predictions. First, consistent with prior work (Nosek, Banaki, & Greenwald 2002), we predict that female participants will exhibit more negative attitudes toward math than male participants, but that these attitudes will not be differentially activated by signing their name. Second, we predict that signing will moderate the relationship between self-perceived talent and performance and, to the extent that there is a gender gap in self-perceived talent, will moderate the relationship between gender and performance. Finally, because signing activates one's self-concept rather than one's attitude, we predict that signing will not moderate the relationship between attitudes toward math and performance.

Method

Participants. Participants were 142 volunteers (68 female, 74 male) who participated in a series of studies for a monetary reward. Six participants were removed because their error rates exceeded 30% in the evaluation task.

Design. A 2 (signature: required, not required) × 2 (math problem preview: yes, no) between-subjects design was used. Each participant completed two tasks: a sequential evaluative priming task, followed by 5 GMAT problems (identical to those used in study 2).

Procedure. The study was completed in five steps. First, participants were given a description of the automatic evaluation task, and completed 8 practice trials. Second, they completed an (ostensibly unrelated) paper-based study, which contained the signature task and the math problem preview manipulations. Third, participants completed the 48 focal trials of the automatic evaluation task. Fourth, participants were given up to 10 minutes to attempt to solve up to 5 GMAT problems. Finally, they answered a series of questions about themselves, and completed the Abbreviated Math Anxiety scale (Hopko 2003).

Signature Manipulation. The manipulation was identical to that used in study 2.

Math Problem Preview. Immediately after completing the handwriting manipulation, participants assigned to preview a math problem were shown a sample quantitative GMAT problem, and informed that: "Later on in this session, you will be asked to solve 5 GMAT problems. Due to university ethics regulations, we are required to show you an example before you begin that task. Therefore, a sample question is below."

Automatic Evaluation Task. We created a computer-based automatic evaluation task based on the instructions in Ferguson (2007). Each trial consisted of a 1-second exposure to a

prime word (in the center of the computer screen), followed immediately by a target adjective and two buttons labeled "Good" and "Bad". Participants' task was to categorize the target adjective as quickly as possible.

Three types of prime words were used: neutral primes (chair, city, country, desk, engage, grasp, listen, observe, sofa, stroll, table, whistle), math-related primes (algebra, arithmetic, calculate, calculus, math, statistics), and arts-related primes (arts, books, film, literature, reading, writing). Target adjectives were either positive-valence (amazing, awesome, delightful, excellent, fabulous, fantastic, magnificent, spectacular, splendid, superb, terrific, wonderful), or negative-valence (awful, disgusting, dreadful, hideous, horrendous, horrible, miserable, repulsive, revolting, sickening, terrible, unpleasant).

Participants completed a total of 48 trials, divided into two sets of 24 trials (separated by a 20-second break). Within each set of 24 trials, each participant was exposed to each prime and each adjective exactly once, and each type of prime was paired with each adjective valence an equal number of times; within those constraints, specific adjectives and primes were assigned randomly.

The key dependent measure is response time for the categorization of positive-valence as compared to negative-valence adjectives. For a given prime, if a participant responds more slowly when that prime is paired with a positive adjective as compared to a negative adjective, we interpret that as evidence of a negative attitude toward the prime. To examine the valence of one's attitude toward math, therefore, we compare response times (for positive as compared to negative adjectives) for the math primes to response times for the neutral primes.

Results

Preliminary Analyses. As compared to males, female participants were significantly lower in self-perceived talent ($M_{female} = 3.3$, $M_{male} = 4.2$, $p < .01$), a difference that was marginally greater in the math problem preview condition ($M_{female.no.preview} = 3.4$, $M_{male.no.preview} = 3.9$, $M_{female.preview} = 3.2$, $M_{male.preview} = 4.5$, interaction $p < .10$). Females were significantly less motivated ($M_{female} = 3.5$, $M_{male} = 4.7$, $p < .01$), and enjoyed the math problems less ($M_{female} = 3.1$, $M_{male} = 4.2$, $p < .01$), but there was no gender difference in perceived difficulty ($p = .48$). Neither the signature manipulation ($ps > .45$) nor the math preview ($ps > .18$) moderated these differences.

Automatic Evaluation Task. We conducted our analyses on two sets of data. Consistent with Ferguson (2007), we applied a logistic transformation to the response latency measures (which exhibited a right skew due to their inherent non-negativity constraint; see Bargh & Chartrand 2000), we removed incorrect responses (error rate was 5%), and response times that were slower than 3000 ms. In line with Greenwald, Nosek, and Banaji (2003), we also conducted our analyses on the full set of data (with log-transformed response latencies). The results did not substantively differ across the data sets; therefore we report results from the complete data set.

First, we examine the role of gender on math-related attitudes with a linear mixed-effects model – with the dependent variable being response time – on the following independent variables: prime type (control vs. arts vs. math), adjective valence (positive vs. negative), signature manipulation (control vs. sign name), math problem preview (control vs. preview), gender, all interactions, and with a random effect for each participant. We find two significant interaction terms. First, a significant prime type × adjective valence × gender interaction

emerges; planned contrasts reveal that, as compared to male participants, female participants exhibited significantly more negative evaluations of math primes ($t(134) = 2.03$, $p < .05$). Second, there is a marginally significant prime type × adjective valence × math preview interaction, which indicates that participants who were given the preview exhibited marginally more positive evaluations of math primes than those who did not receive the preview ($t(134) = 1.64$, $p = .10$). However, although females exhibited significantly more negative attitudes toward the math primes, this difference was not moderated by either the signature intervention or the math preview (ps > .50). A similar regression using self-perceived talent as an independent variable reveals a similar pattern of results: neither the signature manipulation nor the math preview influenced participants' evaluation of math primes as a function of their self-perceived level of math talent.

Math Performance. First, we examine the role of gender (same methods as study 2). A significant handwriting manipulation × math problem preview × gender interaction emerges ($\beta = -0.29$, $p < .01$). Contrasts reveal that the general self-concept prime moderated the effect of the math problem preview on the performance of females, but not males. In the absence of a signature, a significant positive math problem preview × gender interaction emerges ($\beta = 0.23$, $p < .05$), which indicates that the math preview induced female participants to perform worse ($P_{\text{female.no.sign.no.preview}} = 42\%$, $P_{\text{female.no.sign.preview}} = 34\%$, $p < .05$), whereas males were unaffected ($p = .76$). In the presence of the signature treatment, however, a significant negative math problem preview × gender interaction emerges ($\beta = -0.35$, $p < .01$). Females who viewed the the math problem preview after signing their name performed better ($P_{\text{female.sign.no\_preview}} = 41\%$, $P_{\text{female.sign.preview}} = 50\%$, $p < .01$), whereas males were not affected ($p = .24$). Thus, the math

problem preview hindered females' performance in the absence of the general self-concept prime, but enhanced it after the general self-concept prime (see figure 4a).

Second, we examine the role of self-perceived talent. The handwriting manipulation × math problem preview × talent interaction is not significant ($p = .53$), nor is the preview × talent interaction ($p = .72$). However, consistent with the results of the first three studies, a significant handwriting manipulation × talent interaction emerges ($\beta = 0.12$, $p < .05$; see figure 4b). Signing enhanced the performance of participants at higher levels of self-perceived talent ($\beta = 0.47$, $p < .001$), but did not hinder the performance of participants at lower levels of self- perceived talent ($p = .73$). Similar regressions reveal that performance was not influenced by the interplay of signing, the math preview, and either math anxiety (ps > .58), motivation (ps > .27), task enjoyment (ps > .59), or perceived difficulty of the problems (ps > .38).

Finally, we examine the role of attitudes toward math, as revealed by the automatic evaluation task. We constructed a score for each participant that reflects the difference in their response time for math primes (as compared to neutral primes) when paired with negative-valence versus positive-valence adjectives. Neither the main effect for this attitude score, nor any of the interactions were statistically significant (ps > .37). This non-effect is critical in light of the fact that female participants exhibited significantly more negative attitude scores than did males, for it clearly indicates that the effect of a general self-concept prime on performance is not driven by the activation of one's attitudes.

Discussion

The results of study 4 support our theoretical account of how a general self-concept prime influences performance, and provide additional insight into the contrasting roles of gender

identity and self-perceived talent. Although females demonstrated significantly more negative attitudes toward math than did males, those attitudes were not differentially activated by whether they signed their name or previewed a difficult math problem, nor did they interact with either manipulation to influence performance. Further, the general self-concept prime and math problem preview interacted with both gender and self-perceived talent to influence subsequent performance, but did so in different ways. Consistent with results from studies 1-3, the signature manipulation strengthened the relationship between self-perceived talent and performance. The math problem preview, on the other hand, hindered the performance of females who had not signed their name, but enhanced the performance of females who had signed.

GENERAL DISCUSSION

Although there is little debate about the existence of a gender gap in math performance, there remains considerable uncertainty about the exact causes of that gap. We have introduced the hypothesis that a general self-concept prime – such as signing one's name – may increase the gender gap in math performance by activating individuals' self-perceived talent level. Evidence from four studies – examining different populations of students and involving different measures of attitudes toward math – demonstrates that signing reliably influences math performance. Critically, in populations in which males have higher levels of self-perceived talent, signing widens the gender gap in math performance.

We have introduced the hypothesis that among individuals with advanced math ability – such as those in math-intensive fields – a gender gap in math performance may emerge even though females in that field do not perceive themselves to lack ability. Using a general self-concept prime (Kettle & Häubl 2011), we present results from four studies that demonstrate that a general self-concept prime reliably strengthens the relationship between self-perceived talent

and performance. Moreover, whereas the general self-concept prime hinders the performance of females with lesser math skills (female undergraduates in an introductory-level course), it does not hinder of the performance of females with advanced math ability (e.g., accounting students). This pattern of results suggests that females with advanced math ability do not perceive the negative stereotype about the math ability of females to be a relevant aspect of their self-concept.

Our results provide a novel perspective on the research indicating that the performance of females is hindered by the activation of negative stereotypes about their math ability (e.g., Bielock et al. 2010). Many scholars argue that this stereotype is waning in Western society (e.g., Feingold 1988), despite its persistence in many cultures (Hyde & Mertz 2009), and strong evidence of a positive correlation between the gender gap and the strength of the stereotype (Fryer & Levitt 2009). Our results suggest that only females in certain populations (such as undergraduate female students in an introductory-level course) have the negative stereotype as an aspect of their self-concept. However, the results of study 4 suggest that, in a population where males have higher levels of self-perceived talent than females, a general self-concept prime may broaden the gender gap by enhancing males' performance rather than hindering females' performance. Thus, efforts to eradicate the negative stereotype about the math ability of females may not decrease the gender gap in math-intensive fields.

The present research makes a key contribution to our understanding of gender differences in math performance. First, it points to a critical underlying aspect of the self-concept – one's self-perceived level of talent – that reliably moderates effects on performance. Moreover, it suggests that a gender difference in self-perceived talent is a necessary condition for a general self-concept prime to increase the gender gap. Second, it suggests that the gender gap is not always due to the perceived inferiority of females, but may actually be broadened by the

interplay of a general self-concept prime and the high levels of self-perceived talent of males. In fact, signing enhanced the performance of males in studies 2 and 4.

The present work suggests several directions for future research. First, although our results highlight the importance of self-perceived talent, the results of studies 1 and 4 suggest that both the self-perceived talent and gender identity of females may be concurrently activated by the general self-concept prime. Future work should aim to identify the necessary conditions for the activation of both aspects. Second, the results of study 4 suggest that a general self-concept prime can produce contrast effects, in that females who had signed their name performed worse in the absence of a math problem preview, but performed better when given the preview. This pattern of results is consistent with prior work showing that blatant (as compared to subtle) interventions promote contrast effects (Cheryan & Bodenhausen 2000; Johns, Schmader, and Martens 2005; Shih et al. 2002), and requires further exploration.

This article's key finding – that providing a signature predictably influences math performance – has practical implications for researchers and educators. Students are routinely required to sign their name immediately prior to taking an exam, either by signing into an exam room or by signing the exam booklet. Our findings suggest that this seemingly innocuous intervention may actually broaden the gender gap, and that it might therefore be desirable to postpone the elicitation of test takers' signatures until after the exam is finished.

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FIGURE 1. EFFECT OF GENERAL SELF-CONCEPT PRIME ON MATH PERFORMANCE (STUDY 1)

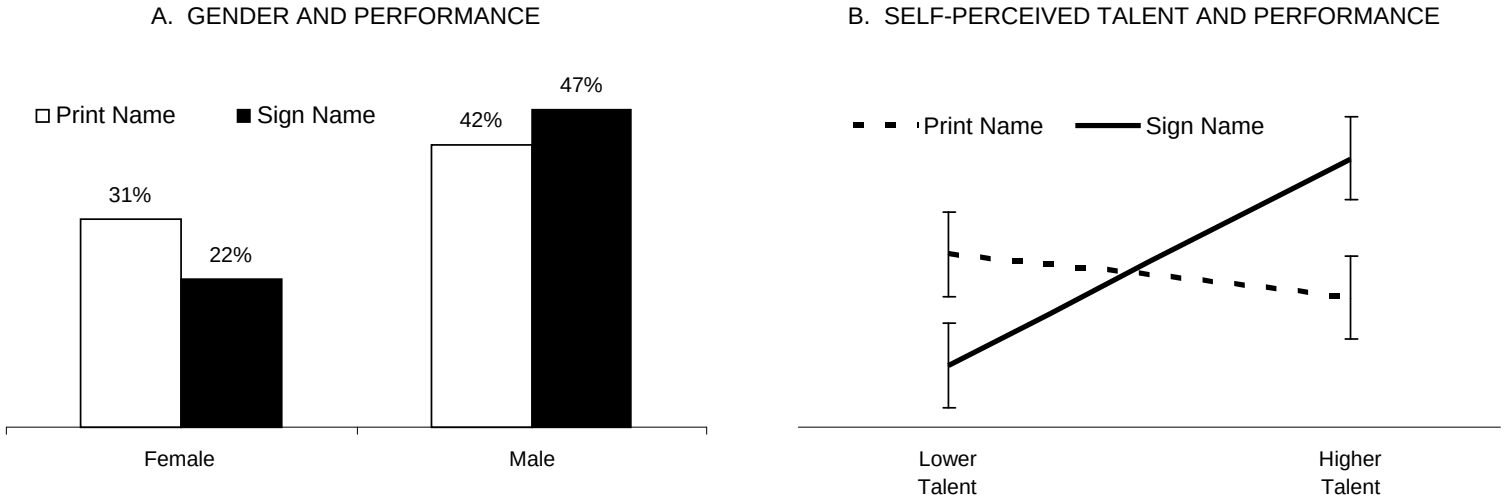
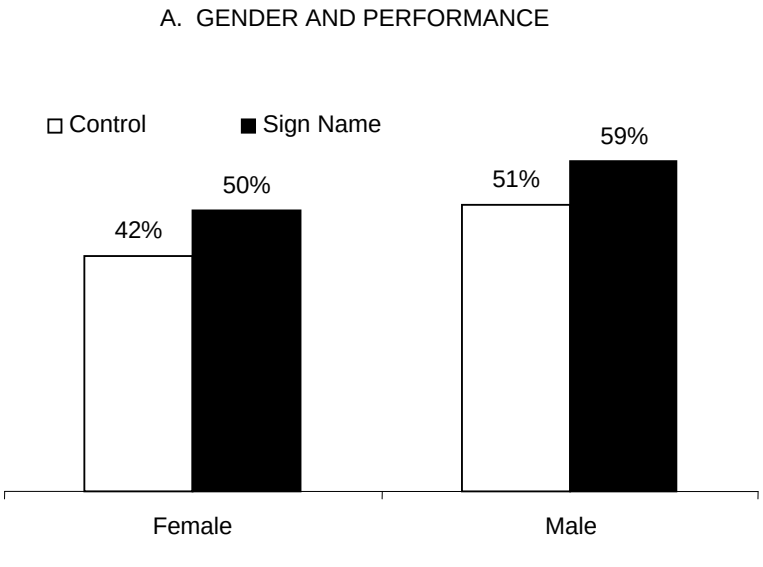


FIGURE 2. EFFECT OF GENERAL SELF-CONCEPT PRIME ON MATH PERFORMANCE (STUDY 2)



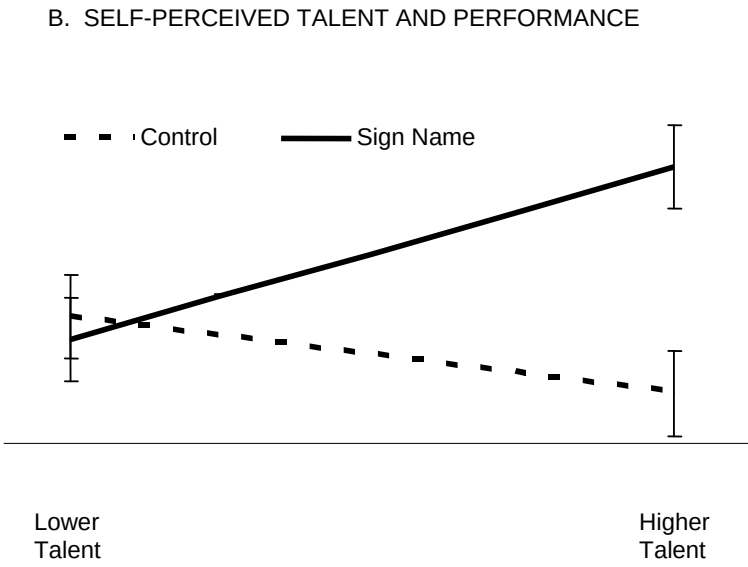


FIGURE 3. EFFECT OF GENERAL SELF-CONCEPT PRIME ON MATH PERFORMANCE (STUDY 3)

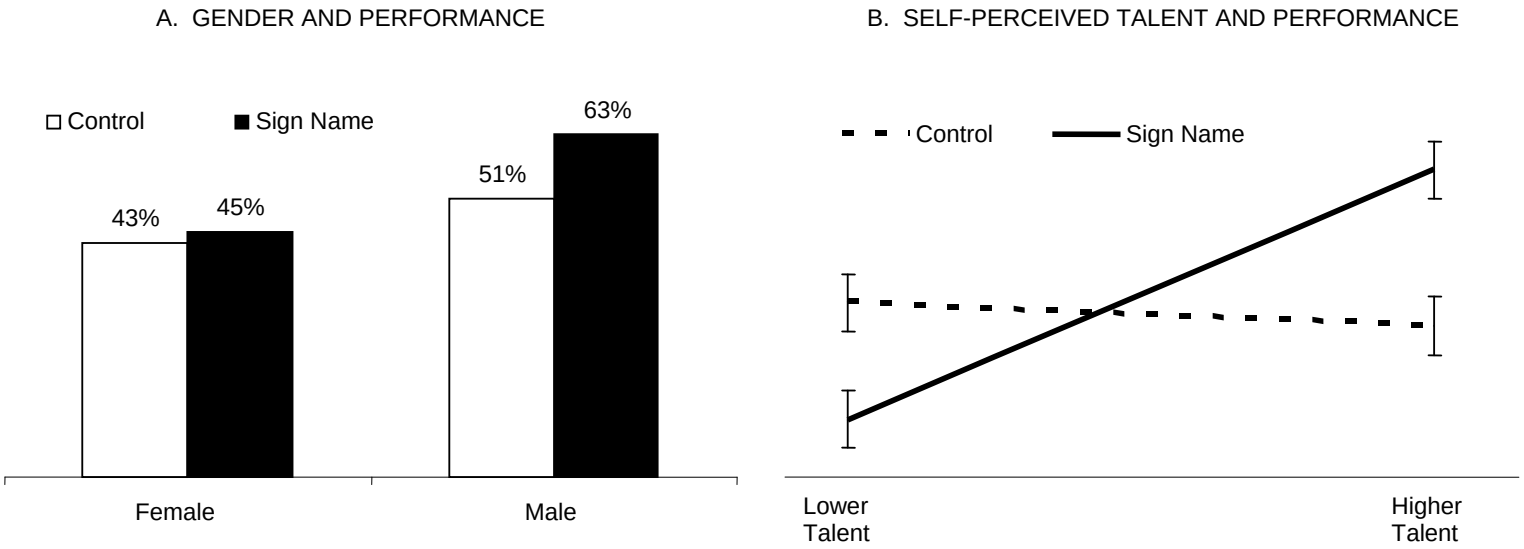
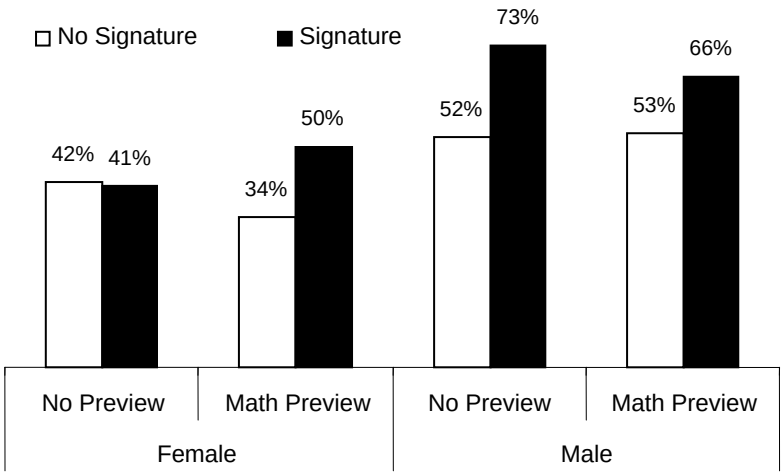
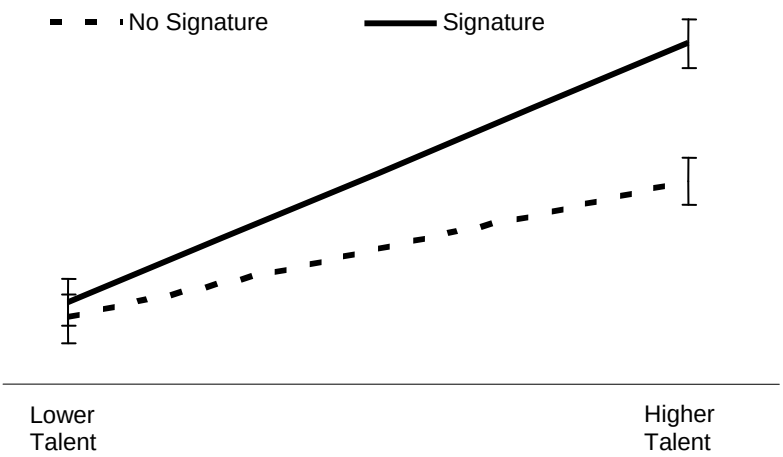


FIGURE 4. EFFECT OF GENERAL SELF-CONCEPT PRIME ON MATH PERFORMANCE (STUDY 4)

A. GENDER AND PERFORMANCE



B. SELF-PERCEIVED TALENT AND PERFORMANCE



APPENDIX A. GMAT MATH PROBLEMS (ALL STUDIES)

Study		Problem Description	Alternatives					Solution
1	2-4		A	B	C	D	E	
1	1	A poultry farm has only chickens and pigs. When the manager of the poultry counted the heads of the stock in the farm, the number totaled up to 200. However, when the number of legs was counted, the number totaled up to 540. How many chickens were there in the farm?	70	120	60	130	80	D
2	2	Three years back, a father was 24 years older than his son. At present the father is 5 times as old as the son. How old will the son be three years from now?	12 yrs	6 yrs	3 yrs	9 yrs	27 yrs	D
3		For what values of 'k' will the pair of equations 3x + 4y = 12 and kx + 12y = 30 not have a unique solution?	12	9	3	7.5	2.5	B
4	3	The basic one-way air fare for a child aged between 3 and 10 years costs half the regular fare for an adult plus a reservation charge that is the same on the child's ticket as on the adult's ticket. One reserved ticket for an adult costs $216 and the cost of a reserved ticket for an adult and a child (aged between 3 and 10) costs $327. What is the basic fare for the journey for an adult?	$111	$52.50	$210	$58.50	$6	C
5		The average of 5 consecutive integers starting with m as the first integer is n. What is the average of 9 consecutive integers that start with m+2?	m + 4	n + 6	n + 3	m + 5	n + 4	E
6		The sum of the fourth and twelfth term of an arithmetic progression is 20. What is the sum of the first 15 terms of the arithmetic progression?	300	120	150	170	270	C
7		If the mean of numbers 28, x, 42, 78 and 104 is 62, then what is the mean of 128, 255, 511, 1023 and x?	395	275	355	415	365	A
8		The arithmetic mean of the 5 consecutive integers starting with 's' is 'a'. What is the arithmetic mean of 9 consecutive integers that start with s + 2?	2 + s + a	2 + a	2s	2a + 2	4 + a	E
9		The average weight of a group of 30 friends increases by 1 kg when the weight of their football coach was added. If the average weight of the group after including the weight of the football coach is 31kgs, what is the weight of their football coach in kgs?	31 kg	61 kg	60 kg	62 kg	91 kg	B
10		The average wages of a worker during a fortnight comprising 15 consecutive working days was $ 90 per day. During the first 7 days, his average wages was $ 87/day and the average wages during the last 7 days was $ 92 /day. What was his wage on the 8th day?	$83	$92	$90	$97	$104	D
11	4	The average of 5 quantities is 6. The average of 3 of them is 8. What is the average of the remaining two numbers?	4	5	3	3.5	0.5	C
12		Vertices of a quadrilateral ABCD are A(0, 0), B(4, 5), C(9, 9) and D(5, 4). What is the shape of the quadrilateral?	square	rectangle but not a square	rhombus	parallelogram but not a rhombus	kite	C
13	5	What is the measure of the radius of the circle that circumscribes a triangle whose sides measure 9, 40 and 41?	6	4	24.5	20.5	12.5	D
14		If the sum of the interior angles of a regular polygon measures up to 1440 degrees, how many sides does the polygon have?	10 sides	8 sides	12 sides	9 sides	none of these	A
15	6	What is the radius of the in circle of the triangle whose sides measure 5, 12 and 13 units?	2 units	12 units	6.5 units	6 units	7.5 units	A
16	7	A cube of side 5cm is painted on all its side. If it is sliced into 1 cubic centimeter cubes, how many 1 cubic centimeter cubes will have exactly one of their	9	61	98	54	64	D

		sides painted?						
17		A wheel of a car of radius 21 cms is rotating at 600 RPM. What is the speed of the car in kilometres per hour?	79.2 kph	47.52 kph	7.92 kph	39.6 kph	3.96 kph	B
18		The area of a square field is 24200 sq m. How long will a lady take to cross the field diagonally at the rate of 6.6 km/hr?	3 minutes	0.04 hours	2 minutes	2.4 minutes	2 minutes 40 seconds	C
19		A lady grows cabbages in her garden that is in the shape of a square. Each cabbage takes 1 square feet of area in her garden. This year, she has increased her output by 211 cabbages as compared to last year. The shape of the area used for growing the cabbages has remained a square in both these years. How many cabbages did she produce this year?	11236	11025	14400	12696	cannot be determined	A
20	8	A number when divided by a divisor leaves a remainder of 24. When twice the original number is divided by the same divisor, the remainder is 11. What is the value of the divisor?	13	59	35	37	12	D
21		How many keystrokes are needed to type numbers from 1 to 1000?	3001	2893	2704	2890	none of these	B
22		When 242 is divided by a certain divisor the remainder obtained is 8. When 698 is divided by the same divisor the remainder obtained is 9. However, when the sum of the two numbers 242 and 698 is divided by the divisor, the remainder obtained is 4. What is the value of the divisor?	11	17	13	23	none of these	C
23		How many integral divisors does the number 120 have?	14	16	12	20	none of these	B
24		How many trailing zeros will be there after the rightmost non-zero digit in the value of 25!?	25	8	6	5	2	C
25		What is the remainder when 1044 * 1047 * 1050 * 1053 is divided by 33?	3	27	30	21	18	C
26		If the price of gasoline increases by 25% and Ron intends to spend only 15% more on gasoline, by what % should he reduce the quantity of petrol that he buys?	10%	12.5%	8%	12%	6.66%	C
27		Robin earns 30% more than Erica. Charles earns 60% more than Erica. How much % is the wages earned by Charles more than that earned by Robin?	23%	18.5%	30%	50%	100%	A
28		In an election contested by two parties, Party D secured 12% of the total votes more than Party R. If party R got 132,000 votes, by how many votes did it lose the election?	240,000	300,000	168,000	36,000	24,000	D
29		The difference between the value of a number increased by 12.5% and the value of the original number decreased by 25% is 30. What is the original number?	60	80	40	120	160	B
30		What is the % change in the area of a rectangle when its length increases by 10% and its width decreases by 10%?	0%	20% increase	20% decrease	1% decrease	none of these	D
31		If the cost price of 20 articles is equal to the selling price of 25 articles, what is the % profit or loss made by the merchant?	25% loss	25% profit	20% loss	20% profit	5% profit	C
32	9	Sam buys 10 apples for $1. At what price should he sell a dozen apples if he wishes to make a profit of 25%?	$0.125	$1.25	$0.25	$1.50	$1.80	D
33		By selling an article at 80% of its marked price, a merchant makes a loss of 12%. What will be the % profit made by the merchant if he sells the article at 95% of its marked price?	5% profit	1% loss	10% profit	5.5% profit	4.5% profit	E
34	10	What is the maximum percentage discount that a merchant can offer on her Marked Price so that she ends up selling at no profit or loss, if she had initially marked her goods up by 50%?	50%	20%	25%	16.67%	33.33%	E
35		A merchant who marked his goods up by 50% subsequently offered a discount of 20%. What is the percentage profit that the merchant make after offering the discount?	30%	125%	25%	20%	50%	D
36		What is the highest integral value of 'k' for which the	9	7	3	8	12	D

		quadratic equation x2 - 6x + k = 0 have two real and distinct roots?						
37	11	If one of the roots of the quadratic equation x2 + mx + 24 = 0 is 1.5, then what is the value of m?	-22.5	16	-10.5	-17.5	17.5	D
38	12	For what value of 'm' will the quadratic equation x2 – mx + 4 = 0 have real and equal roots?	16	8	2	-4	(B) and (C)	D
39		Three friends Alice, Bond and Charlie divide $1105 amongst them in such a way that if $10, $20 and $15 are removed from the sums that Alice, Bond and Charlie received respectively, then the share of the sums that they got will be in the ratio of 11:18:24. How much did Charlie receive?	$495	$510	$480	$375	$360	A
40		Mary and Mike enter into a partnership by investing $700 and $300 respectively. At the end of one year, they divided their profits such that a third of the profit is divided equally for the efforts they have put into the business and the remaining amount of profit is divided in the ratio of the investments they made in the business. If Mary received $800 more than Mike did, what was the profit made by their business in that year?	$2000	$6000	$4000	$1333	$3000	E
41		A, B and C, each of them working alone can complete a job in 6, 8 and 12 days respectively. If all three of them work together to complete a job and earn $ 2340, what ill be C's share of the earnings?	$1100	$520	$1080	$1170	$630	B
42		In what ratio should a 20% methyl alcohol solution be mixed with a 50% methyl alcohol solution so that the resultant solution has 40% methyl alcohol in it?	1 : 2	2 : 1	1 : 3	3 : 1	2 : 3	A
43		In a class of 120 students numbered 1 to 120, all even numbered students opt for Physics, whose numbers are divisible by 5 opt for Chemistry and those whose numbers are divisible by 7 opt for Math. How many opt for none of the three subjects?	19	41	21	57	26	B
44	13	Of the 200 candidates who were interviewed for a position at a call center 100 had a two-wheeler, 70 had a credit card and 140 had a mobile phone. 40 of them had both, a two-wheeler and a credit card, 30 had both, a credit card and a mobile phone and 60 had both, a two wheeler and mobile phone and 10 had all three. How many candidates had none of the three?	0	20	10	18	25	C
45	14	In a class of 40 students, 12 enrolled for both English and German. 22 enrolled for German. If the students of the class enrolled for at least one of the two subjects, then how many students enrolled for only English and not German?	30	10	18	28	32	C
46		Braun invested a certain sum of money at 8% p.a. simple interest for 'n' years. Shawn invested one half of his savings in a bond that paid simple interest for 2 years and received $ 550 as interest. At the end of 'n' years, Braun got back 4 times his original investment. What is the value of n?	50 years	25 years	12 years 6 months	37 years 6 months	40 years	D
47		Shawn invested one half of his savings in a bond that paid simple interest for 2 years and received $ 550 as interest. He invested the remaining in a bond that paid compound interest, interest being compounded annually, for the same 2 years at the same rate of interest and received $605 as interest. What was the value of his total savings before investing in these two bonds?	$5500	$11000	$22000	$2750	$44000	D
48	15	Ann invested a certain sum of money in a bank that paid simple interest. The amount grew to $240 at the end of 2 years. She waited for another 3 years and got a final amount of $300. What was the principal amount that she invested at the beginning?	$200	$150	$210	$175	$220	A
49		Peter invested a certain sum of money in a simple interest bond whose value grew to $300 at the end of 3 years and to $ 400 at the end of another 5 years. A train traveling at 72 kilometers per hour (kph) crosses	12%	12.5%	6.67%	6.25%	8.33%	E

		a platform in 30 seconds and a man standing on the platform in 18 seconds. What was the rate of interest in which he invested his sum?						
50		A train traveling at 100 kilometres per hour (kph) overtakes a motorbike traveling at 64 kph in 40 seconds. What is the length of the platform in meters?	240 m	360 m	420 m	600 m	720 m	A
51		A train traveling at 100 kilometres per hour (kph) overtakes a motorbike traveling at 64 kph in 40 seconds. What is the length of the train in meters?	1777 m	1822 m	400 m	1111 m	1400 m	C
52	16	Jim travels the first 3 hours of his journey at 60 kilometres per hour (kph) speed and the remaining 5 hours at 24 kph speed. What is the average speed of Jim's travel in kph?	42 kph	36 kph	37.5 kph	42.5 kph	48 kph	C
53	17	A runs 25% faster than B and is able to give him a start of 7 meters to end a race in dead heat. What is the length of the race?	10 m	25 m	45 m	15 m	35 m	E
54	18	Jane covered a distance of 340 miles between city A and city taking a total of 5 hours. If part of the distance was covered at 60 miles per hour speed and the balance at 80 miles per hour speed, how many hours did she travel at 60 miles per hour?	2 hours 30 minutes	3 hours	2 hours	1 hour 45 minutes	1 hour 30 minutes	B
55		Steve traveled the first 2 hours of his journey at 40 kilometres per hour (kph) and the remaining 3 hours of his journey at 80 kph. What is his average speed for the entire journey?	60 kph	56.67 kph	53.33 kph	64 kph	66.67 kph	D
56	19	Working together, Jose and Jane can complete an assigned task in 20 days. However, if Jose worked alone and complete half the work and then Jane takes over the task and completes the second half of the task, the task will be completed in 45 days. Assuming that Jane is more efficient than Jose, how long will Jose take to complete the task if he worked alone?	25 days	30 days	60 days	65 days	36 days	C
57		A can complete a project in 20 days and B can complete the same project in 30 days. If A and B start working on the project together and A quits 10 days before the project is completed, in how many days will the project be completed?	18 days	27 days	26.67 days	16 days	12 days	A
58	20	Ram, who is half as efficient as Krish, will take 24 days to complete a work if he worked alone. If Ram and Krish worked together, how long will they take to complete the work?	16 days	12 days	8 days	6 days	18 days	C

APPENDIX B. UFE PROBLEMS (STUDY 3)

No	Problem Description	Alternatives					Solution
		A	B	C	D	E	
1	Adelle Ltd. uses the installment method of accounting for installment sales. The company's installment sales for the year ended December 31, 2000 were $600,000. The cost of sales was $400,000. Cash collected for these sales in 2000 was $210,000. How much gross profit relating to these sales will be included in Adelle's income statement for the year ended December 31, 2000?	$0	$70,000	$140,000	$200,000	$210,000	B
2	On January 1, 2000 CL signed a lease on a property for a non-cancellable period of 5 years. At the end of this period the company can acquire the property for 30% of its fair value or sign a bargain renewal option for an additional 10 years. Once the 10 years are up, CL has two other renewal options, each for 5 years at the market price. What is the term of the lease?	5 years	10 years	15 years	20 years	25 years	C
3	Which of the following cost structures has the lowest sales revenue break-even point?	Fixed costs of $1,000 and variable costs of 70% of sales	Fixed costs of $2,000 and variable costs of 55% of sales	Fixed costs $2,500 and variable cos of 61% of sales	Fixed costs of $3,000 and variable costs of 23% of sales	Fixed costs of $4,000 and no variable costs	A
4	ST Ltd. wishes to use the direct method to present its statement of changes in financial position. Net Income … $165,000 Sales … $350,000 Reduction in AR … $10,000 Amortization … $20,000 Based on the information presented, what amount should be reported for "Cash from Clients?"	$175,000	$195,000	$215,000	$340,000	$360,000	E
5	A parent company acquires 80% of the shares of a subsidiary for $400,000. The carrying value of the subsidiary's net assets is $350,000. The fair market value of the net assets of the subsidiary is $380,000. How much goodwill should be recorded at the time of acquisition?	$16,000	$20,000	$60,000	$96,000	$120,000	D
6	For the credit note issuance subsystem, inherent risk has been set at low (a numeric value of 60%), and control risk has been set at 1.0 (no reliance) since the small population makes tests of detail cost-effective. Audit risk is set at 2%. Which one of the following percentages represents the numeric value of planned detection risk?	2.5%	3.3%	95%	96.7%	97.5%	B
7	Division Alpha produces an component used in the manufacture of equipment by Division Beta. The component is also sold to other manufacturers at the market price of $53 per unit. The cost, in Division Alpha, to produce one unit of the component, is: Direct Material … $17.10 Direct Labour … $6.32 Variable Overhead … $3.57 Fixed Overhead … $8.71 Div Alpha has a capacity of 100,000 units, transfers 60,000 units to Div Beta, and sells 20,000 units to other manufacturers. Which one of the following amounts represents the minimum per unit transfer price Division Alpha should accept if Division Beta requested a	$23.42	$25.34	$26.99	$35.70	$53.00	C

	special order of 10,000 components?						
8	Mr. Smith, the sole shareholder and employee of Smithco Ltd. since its incorporation in 1990, has decided to retire after working for 20 years. He has never belonged to a pension plan, and wishes to maximize his RRSP. Which one of the following amounts repressents the largest retiring allowance from Smithco that Mr. Smith can transfer to his RRSP in the years he retires?	$40,000	$50,000	$56,000	$59,500	$70,000	D
9	Mr. Brown's employer provides an automobile for his personal use and pays all operating costs for that vehicle. The vehicle, used by Mr. Brown throughout 2009, cost his employer $32,100, including GST. Mr. Brown drove the vehicle 45,00 km in the year, of which 9,000 km were for personal purposes. Mr. Brown paid nothing to his employer for the use of the vehicle. Which one of the following amounts represents the minimum benefit that Mr. Brown must include in his employment income for the use of this vehicle in 2009?	$5,778	$8,784	$9,054	$10,204	$11,304	B
10	For 2005, Pat-Claire Inc had sales of $2.5 million, a gross profit of $1 million, and net income of $125,000. Inventory was $250,000 at the beginning of 2005 and $300,000 at the end of the year. Which one of the following numbers represents the inventory turnover for 2005?	5 times	5.45 times	6 times	6.36 times	9.09 times	B

CHAPTER 4: ESSENTIAL PROPERTIES OF A GENERAL SELF-CONCEPT PRIME

ABSTRACT

Results from four studies demonstrate that a general self-concept prime results from engagement in an identity-relevant action, but not from exposure to an identity-relevant image. Our investigation reveals that it is the physical action of producing one's signature – and not viewing one's handwritten signature – that produces the self-concept priming effect of signing one's name (studies 1 and 2). We show that two similar automatic identity-relevant actions – typing one's password and entering one's Personal Identification Number (PIN) – also serve as general self-concept primes (study 3). Implications for our understanding of the self-concept are discussed.

The consumer behavior literature is replete with research demonstrating that situational cues, symbols, and actions can differentially activate mental constructs such as goals, traits, identities and stereotypes, and that even seemingly innocuous primes can have strong effects on consumer behavior (Bargh and Chartrand 1999; Berger and Fitzsimons 2009; Sela and Shiv 2009). Recent work suggests that a single intervention – specifically, signing one's name – can act as a general self-identity prime that interacts with situational cues to activate – and promote behavior that is congruent with – the aspect of one's self-identity that is afforded by the situation (Kettle and Häubl 2011a). We herein refer to this phenomenon as a *general self-concept prime*, where the term *self-concept* refers to the totality of all self-schemas that form one's sense of self (Markus and Kunda 1986). Whereas prior work focused on the association between one's signature and one's identity, recent evidence (Kettle and Häubl 2011b) indicates that the signature phenomenon is not limited to the activation of specific identities, but more generally primes one's self-concept.

In contrast to other priming interventions, a general self-concept prime does not differentially activate a particular identity, self-schema, stereotype, or aspect of one's self-concept. Rather, a general self-concept prime activates whichever aspect(s) of one's self-concept that is (are) relevant in the present situation. The general self-concept priming effect of signing one's name has been demonstrated across diverse different behavioral domains (Kettle and Häubl 2011a, 2011b), yet little is known about the nature of interventions that serve as a general self-concept prime, or how these differentially prime particular aspects of one's self-concept.

In three studies, we examine the essential properties of the general self-concept prime, and identify two similar behaviors that also act as general self-concept primes. Studies 1 and 2 demonstrate that the physical action of producing one's signature acts as a general self-concept

prime, but that viewing one's signature does not. Study 3 demonstrates other automatic identity-relevant actions that serve as general self-concept primes – typing one's password and entering one's Personal Identification Number (PIN).

PROPERTIES OF A GENERAL SELF-CONCEPT PRIME

We begin our investigation by examining a known general self-concept prime – signing one's name – to determine which constituent elements of the overt physical act of penning one's signature facilitate the general priming of one's self-concept. Building on prior work that indicates that constructs and identities can be activated by either engaging in construct-relevant behavior (e.g., Mussweiler 2006) or through exposure to a construct-relevant image – such as a brand or a photo – (e.g., Fitzsimons, Chartrand, and Fitzsimons 2008), we contrast two alternative accounts for the general self-concept priming effect of signing one's name: the *self-action* account and the *self-symbol* account.

A self-action account builds on the theory of ideomotor action (Dijksterhuis and Bargh 2001; Greenwald 1970a, 1970b; James 1890), the central tenet of which is that overt physical actions are associated with mental representations of those actions. Activation of the mental representation of a physical action is thus sufficient to induce that action (Dijksterhuis and Bargh 2001) and, conversely, engaging in a physical action is sufficient to activate associated mental representations (Mussweiler 2006; Schubert and Koole 2008). For example, inducing people to walk slowly activates an elderly stereotype, while forcing people to walk in a manner consistent with fat people activates the obese stereotype (Mussweiler 2006), and moving their head in an up-and-down motion while listening to music leads people to agree with a subsequent message (Wells & Petty 1980). Individuals also associate their engagement in particular overt actions with aspects of their self-concept, such as chanting the fight song of their favourite team

(Scheepers, Spears, Doosje, and Manstead 2003) or their alma mater (Studwell 1995), producing a hand sign to indicate group affiliation (Stretesky and Pogrebin 2007), and making "inside jokes" (Bormann 1982). Thus, the key premise underlying the theory of ideomotor action – namely, that interrelated thoughts, perceptions, and actions are co-located within one's memory – suggests that engagement in a motor action that is associated with a particular aspect of one's self-concept should be sufficient to activate that aspect. For instance, because the aspect of one's self-concept that relates to one's college alma mater includes one's closeness of identification with the alma mater and motor actions (e.g., chanting the school's fight song), engagement in that motor action should activate one's identification with the alma mater.

Research suggests that one's signature is not uniquely associated with a particular identity or self-schema, but rather is more generally associated with one's sense of self (Kettle and Häubl 2011a). Consumers produce their signature in a myriad of self-relevant situations, such as to authorize an action (e.g., the purchase or sale of financial instruments), indicate their understanding of a document (e.g., a consent form), commit to the terms of a contract, or release themselves from a commitment (e.g., signing a resignation letter). Recent work indicates that engagement in motor actions that – like a signing one's name – are associated with broad concepts is sufficient to activate those concepts. For instance, extending one's middle finger activates hostility whereas extending one's thumb activates agreement (Chandler and Schwarz 2009), making a fist activates feelings of power in men (Schubert and Koole 2008), using hand gestures helps people to solve spatial problems (Alibali and Spencer 2011), and physically taking a step back enables a broader mental perspective (Koch et al. 2009). A general self-concept prime may thus be seen to influence behavior as follows: engaging in the overt identity-relevant self-action (e.g., signing one's name) activates the mental representation of that action, which –

if the action is generally associated with one's self-concept – then spreads to activate one's self-concept (Jeannerod 1994; Rauscher, Krauss, and Chen 1996). Thus, a self-action account predicts that engaging in the act of signing one's own name will be sufficient to prime one's self-concept.

A self-symbol account of the effect of signing one's name is based on the premise that one's signature serves as a symbol of one's self-concept, much in the same manner that the Apple logo serves as a symbol of that company's corporate brand. Prior work in a number of domains has shown that specific constructs or identities can be primed by exposing a person to symbols, including brand logos (Chartrand, Huber, Shiv, and Tanner 2008; Fitzsimons et al. 2008), brand names (Anderson, Benjamin, and Bartholow 1998), role models (Lockwood and Kunda 1997), objects in the environment (Berger and Fitzsimons 2008), and images of people (Bargh et al. 1996; McKee et al. 2006). Consumers also use symbols to represent specific aspects of their self-concept – such as crucifixes to represent their religious denomination (Dotson and Hyatt 2000) and team logos to represent their association with sports teams (Donavan, Janda, and Suh 2006) – and exposure to such a symbol can differentially activate particular traits, beliefs, thoughts, and behaviors associated with that aspect of one's self-concept (e.g., Bry, Follenfant, and Meyer 2008; Forehand and Deshpandé 2001; Sela and Shiv 2009). Similar to research on motor actions recent work indicates that exposure to images that – like one's signature – are associated with broad concepts is sufficient to activate those concepts. For instance, exposure to images of guns primes aggression (Anderson et al. 1998), but only to the extent that an individual associates the particular gun with acts of aggression (Bartholow, Anderson, Carnagey, and Benjamin 2005). A general self-concept prime may thus be seen to influence behavior as follows: exposure to the identity-relevant self-symbol (e.g., one's

signature) activates the mental representation associated with that image, which – if the image is generally associated with one's self-concept – then spreads to activate one's self-concept. Thus, a self-symbol account predicts that mere exposure to one's previously penned signature will be sufficient to prime one's self-concept.

STUDY 1

Study 1 was designed to examine separately the constituent elements of the act of signing one's name: the physical act of penning one's signature, and exposure to one's own signature. To do so, we independently manipulated whether participants engaged in the motor action of producing their signature, and whether they were exposed to their penned signature.

We used an identity-signaling paradigm from Kettle and Häubl (2011a) requiring participants to make choices in 19 different preference domains that vary in the extent to which they are relevant to signaling one's social identity. We constructed an identity-relevance score for each preference domain, such that the least identity-relevant domain was assigned a value of 1 and the most identity-relevant one was given a value of 19 (see appendix A). After naming a group to which they belong (i.e., an in-group), for each of the 19 domains participants were asked to indicate which of three available options they would choose, having been provided with information about the preferences of the members of the in-group they had named. The three options varied in terms of how popular they were with the members of that specific social group. Choice of the most popular option indicated conformity to the social group, whereas choice of the least popular option indicated divergence from it (see Berger and Heath 2007).

Based on the results of Kettle and Häubl (2011a), we interpret greater conformity with an in-group as evidence that one's self-concept has been primed. Thus, in line with our theorizing about the self-action and self-symbol accounts, we anticipate three possible outcomes. First, if

the self-action account is supported, then we should observe a main effect for engagement in the motor action of producing one's signature, such that doing so leads to greater conformity. Similarly, a main effect for exposure to one's signature (such that viewing one's signature leads to greater conformity) would be interpreted as evidence supporting the self-symbol account. Finally, it is possible that both the motor action and image of one's signature must be present to generally prime one's self-concept. If so, then we should find a significant interaction between the two factors, but no main effects, such that those in the Sign Name condition conform more to the tastes of the in-group than participants in the other conditions.

The identity-signaling paradigm also provides the opportunity to examine how a given situation affords two contrasting aspects of one's self-concept: one's identification with a social group, and one's desire for uniqueness. When provided with information about the preference distribution of a particular group, a consumer faces a conflict between his urge to conform with the group – which he would achieve by choosing the alternative that is most popular with group members – versus his desire to be unique. Because individuals vary in their desire for uniqueness (Berger and Heath 2007; Snyder and Fromkin 1977), we predict that the effect of a general self-concept prime on the tendency to conform will be moderated by an individual's need for uniqueness.

Method

Participants. Participants were 153 undergraduate students who volunteered in exchange for partial course credit.

Design. A 2 (signature motor action: yes, no) × 2 (view signature: yes, no) × 19 (preference domain) mixed design was used, with preference domain being manipulated within-

subject and the two other factors being manipulated between-subjects. Thus, there were four between-subject conditions: Control (motor action = no, view signature = no), View Signature (motor action = no, view signature = yes), Mimic Signature (motor action = yes, view signature = no), and Sign Name (motor action = yes, view signature = yes).

Procedure. The study involved four stages. The first stage, which was completed in a classroom approximately three weeks prior to the remaining stages, required all participants to sign their name on a blank sheet of paper, and to answer a series of questions about themselves, including the Need-for-Uniqueness scale (Snyder and Fromkin 1977). For the remaining stages, participants were seated in private cubicles in a research laboratory.

In the second stage, participants were randomly assigned to one of the four between-subjects conditions. Participants in all conditions read the same cover story about handwriting. Participants in the control condition were told that they would be asked to sign their name later in the session, whereas those in the signature condition signed their name once on a sheet of paper. In the *mimic signature* condition, participants were instructed to keep the cap on the pen while signing their name. In the *view signature* condition, participants were shown an image of their signature (which they had penned weeks earlier) on the computer screen. To ensure that participants viewed their signature, they were required to verify (by clicking on an appropriate button) that the signature was indeed theirs.

After completing the signature manipulation, participants were asked to name an in-group, which they typed into a text box on the computer. The exact instructions were: "In the text box below, please type in the name of a social group that you like and consider yourself quite similar to or belonging to. This group should be a tightly knit group, consisting of individuals who are very similar to one another." Then, participants engaged in the same task as

study 4 of Kettle and Häubl (2011a), in which they made choices in each of 19 preference domains. Finally, participants were asked a series of questions about the social group they had selected. They rated how strongly they identify with that group (1 = very little, 7 = a great deal), how much they like the people in the group (1 = not at all, 7 = a great deal), and how similar they believe they are to the members of the group (1 = extremely dissimilar, 7 = extremely similar).

Results

Preliminary Analyses. Overall, participants identified closely with the in-groups they named ($M = 7.7$), felt similar to group members ($M = 7.1$), and liked group members ($M = 8.0$); none of these ratings varied across conditions (ps > .11). As expected, the inclination to diverge was greater in preference domains that are more relevant to signaling one's identity ($\beta = 0.08$, $p < .001$), and the tendency to conform was lesser in those domains ($\beta = -0.11$, $p < .001$). Participants' tendency to conform was greater the more similar they felt to group members ($\beta = 0.09$, $p < .05$) and the more closely they identified with the group ($\beta = 0.12$, $p < .05$), but was diminished the greater their need for uniqueness ($\beta = -0.02$, $p < .05$).

Hypothesis Tests. Our key prediction was that engaging in the physical act of signing – but not mere exposure to one's signature – would lead participants to make more identity-congruent choices. To test this prediction, we performed a mixed-effects logistic regression with choice of option A – indicating conformity – as the dependent variable and with signature motor action (yes vs. no), view signature (yes vs. no), need-for-uniqueness, and all possible interactions as independent variables, along with random effects for participant and preference domain. As predicted, a significant main effect emerges for signature motor action ($\beta = 0.15$, $p < .05$). The signature motor action × view signature interaction is not significant ($p = .62$), but a significant negative main effect emerges for view signature ($\beta = -0.20$, $p < .05$). This pattern of results

suggests that the act of signing one's name produces an assimilation priming effect, but that viewing one's signature produces a contrast priming effect. Consistent with our second prediction, the act-of-signing × need-for-uniqueness interaction is significant (β = -0.01, p < .05). Spotlight analyses reveal that signing led to greater conformity among participants with low need-for-uniqueness (β = 0.41, p < .01), but not among participants with high need for uniqueness (p = .60). Figure 1 illustrates the nature of the interplay between the motor action of signing, exposure to signature, and need-for-uniqueness on conformity.

To further examine the role of need-for-uniqueness, we also performed a mixed-effects logistic regression with choice of option C – indicating conformity – as the dependent variable and with signature motor action (yes vs. no), view signature (yes vs. no), need-for-uniqueness, and all possible interactions as independent variables, along with random effects for participant and preference domain. A significant signature motor action × need-for-uniqueness interaction emerges (β = 0.01, p = .05). Spotlight analyses reveal that, the motor action of signing decreased divergence among participants lower in need-for-uniqueness (β = -0.39, p < .05), and marginally increased divergence among participants higher in need-for-uniqueness (β = 0.25, p < .09). Although the signature motor action × view signature × need-for-uniqueness interaction is not significant (p = .18), the view signature × need-for-uniqueness interaction is significant, and consistent with a contrast effect (β = -0.02, p < .05). Spotlight analyses reveal that, viewing one's signature led to greater divergence among participants lower in need-for-uniqueness (β = 0.48, p < .05), but actually decreased divergence among participants higher in need-for-uniqueness (β = -0.31, p < .05).

Discussion

The findings of study 1 support the *self-action* account of the general self-concept prime, but do not support the *self-symbol* account. In fact, the results suggest that seeing one's signature produces a contrast effect, rather than an assimilation effect. Signing their name – whether with a capped pen or an uncapped pen – caused participants to conform more with an in-group, and this effect was moderated by chronic need-for-uniqueness. This pattern of results is consistent with recent work indicating that merely engaging in a physical action is sufficient to activate associated mental representations (Mussweiler 2006).

STUDY 2

Study 2 was designed to address two potential issues with study 1 by using different implementations of the physical act of penning one's signature and exposure to one's own signature. One possible concern with the *mimic signature* intervention used in study 1 is that by signing their name with the cap on the pen, participants might potentially see the imprint of their signature on the sheet of paper, which might not be sufficiently distinct from the act of signing with the pen uncapped. To address this issue, in study 2 we had participants sign their name while blindfolded. A possible issue with the *view signature* intervention used in study 1 is that participants may have been concerned by the fact that the researchers had a scanned image of their signature. To address this concern, in study 2 we presented participants with the actual paper copy of their signature, and permitted them to take it with them when they left the study.

Because the goal of study 2 is to verify the key findings of study 1 (namely, that engagement in the motor action of producing one's signature – but no viewing one's signature – serves as a general self-concept prime), we used the same identity-signaling paradigm as in study

1. Our key predictions is that we should observe a main effect for engagement in the motor action of producing one's signature, such that doing so leads to greater conformity.

Method

Participants. Participants were 127 undergraduate students who volunteered in exchange for partial course credit.

Design. A 2 (signature motor action: yes, no) × 2 (view signature: yes, no) × 19 (preference domain) mixed design was used, with preference domain being manipulated within-subject and the two other factors being manipulated between-subjects. Thus, there were four between-subject conditions: Control (motor action = no, view signature = no), View Signature (motor action = no, view signature = yes), Blindfolded Signature (motor action = yes, view signature = no), and Sign Name (motor action = yes, view signature = yes).

Procedure. The procedure was identical to that used in study 1 with one exception: the first stage was completed in the laboratory approximately one week prior to the remaining stages. In the second stage, participants were randomly assigned to one of the four between-subjects conditions. Participants in all conditions read the same cover story about handwriting. Participants in the control condition were told that they would be asked to sign their name later in the session, whereas those in the signature condition signed their name a single time on a sheet of paper. In the *blindfolded signature* condition, participants wore a blindfold while signing their name, and were not permitted to see their actual signature. In the *view signature* condition, participants were given a sheet of paper with their signature (which they had penned a week earlier as part of an unrelated study). The remainder of the procedure was identical to study 1.

Results

Preliminary Analyses. Overall, participants identified closely with the in-groups they named ($M = 7.7$), felt similar to group members ($M = 7.1$), and liked group members ($M = 8.0$); none of these ratings varied across conditions ($ps > .18$). As expected, the inclination to diverge was greater in preference domains that are more relevant to signaling one's identity ($\beta = 0.08$, $p < .05$), and the tendency to conform was lesser in those domains ($\beta = -0.08$, $p < .001$).

Hypothesis Tests. Our key prediction was that engaging in the physical act of signing – but not viewing one's signature – would lead participants to make more identity-congruent choices. To test this prediction, we performed a mixed-effects logistic regression with choice of option A – indicating conformity – as the dependent variable and with signature motor action (yes vs. no), view signature (yes vs. no), and their interaction as independent variables, along with random effects for participant and preference domain. As predicted, a significant main effect emerges for signature motor action ($\beta = 0.23$, $p < .05$). The signature motor action × view signature interaction is not significant ($p = .21$), nor is the main effect for view signature ($p = .55$). Figure 2 illustrates the effect of engagement in the motor act of signing on conformity.

Discussion

The findings of studies 1 and 2 provide strong support for the *self-action* account of the general self-concept priming effect of signing one's name, and do not support the *self-symbol* account. Signing their name – whether blindfolded or not – caused participants to conform more to the preferences of an in-group. This pattern of results is consistent with recent work indicating that merely engaging in a physical action is sufficient to activate associated mental representations (Mussweiler 2006). In this case, signing one's name while blindfolded promotes identity-congruent behavior, but viewing one's own signature does not. We now turn our

attention to identifying other interventions that share the same essential properties as the motor action of signing one's name.

STUDY 3

What are the essential properties of the general self-concept prime? First, the results of studies 1 and 2 indicate that engagement in an identity-relevant motor action – but not exposure to an identity-relevant symbol – acts as a general self-concept prime. Second, prior work has shown that printing one's own name does not serve as a general self-concept prime (Kettle and Häubl 2011a), which indicates that a general self-concept prime must also (1) serve as a means by which a person verifies his or her identity, and (2) be seen as unique to the individual. Although a consumer may print his or her own name to identify himself or herself, a printed name is not seen as verification of one's identity, whereas a signature is (Lemert 1958; Mnookin 2001; Risinger, Denbeaux, and Saks 1989; Weinberg 2003). Similarly, although people may have somewhat unique printing styles, people specifically attempt to create unique signatures in order to prevent their signature from being easily forged (Bensefia, Paquet, and Heutte 2005; Kam, Gummadidala, Fielding, and Conn 2001).

We propose two motor actions that share these same essential properties as the motor action of producing one's signature and that may therefore serve as general self-concept primes: (1) typing in one's primary (e-mail or computer) password, (2) entering one's banking PIN. Like a handwritten signature, these are unique motor actions that people use to verify their identity, and with the preponderance of e-mail communication, online retailing and banking, and the use of ATMs and debit cards, people may enter their password or PIN multiple times each day. Moreover, like signatures, people seek to create unique passwords and PINs and use the same password and PIN for multiple activities. An analysis of passwords stolen from the SONY and

Gawker websites indicates that 80% of the approximately 1 million passwords used by SONY website members were completely unique, and that 67% of individuals who had accounts at both the SONY and Gawker websites used the identical password for both accounts (Hunt 2011). Moreover, recent work shows that entering a sequence of numbers into a phone can activate words associated with that string of numbers (Topolinski 2011), which indicates that typing is a motor action that can automatically activate constructs associated with the characters being entered. Thus, we propose that typing one's password on a QWERTY keyboard and entering one's PIN on a keypad will activate the associated construct – namely, one's self-concept – and will thus serve as general self-concept primes.

In study 3, we examine the motor actions associated with typing one's password into a keyboard and entering one's PIN into a keypad using the same identity-signaling paradigm as in study 1. Our key prediction is that signing one's name, typing one's password into a QWERTY keyboard, and entering one's PIN into a keypad will produce the general self-concept priming effect – namely, they will lead participants to conform more to the in-group.

Method

Participants. Participants were 145 volunteers recruited from a subject pool who participated in exchange for a monetary reward.

Design. A 4 (prime manipulation: control, sign name, password, PIN) × 19 (preference domain) mixed design was used, with preference domain being manipulated within-subject and the other factor being manipulated between-subjects.

Procedure. The procedure was identical to study 2 with the exception of the priming interventions. Participants were randomly assigned to one of the four between-subjects conditions, which we refer to as the Control, Sign Name, Password, and PIN conditions.

Participants in all conditions were given a cover story that the study was about signatures. Participants in the *control* condition and the *sign name* conditions were given the following story: "This study is part of a research project on signatures. With the widespread use of computers, PDA's, and other electronic text-producing devices, people do not practice their hand-writing as frequently as they have in past generations. Yet, the ability to write effectively by hand remains very important in many domains of life." Participants in the *control* condition were also given the instruction "As part of this research, we will ask you to sign your own name later in this session." Those in the *signature* condition were given the instruction "As part of this research, we ask you to sign your own name on the next page."

For the *PIN* condition, the following instructions were given: "With the widespread use of bank cards and credit cards, people are often called upon to use their 4-digit or 6-digit Personal Identification Number (PIN). As part of this research, we are going to ask you to think about your PIN, and to imagine entering it into a keypad." The following sheet of paper contained the image of a PIN keypad and instructions "Please go through the motion of entering your PIN on the keypad (there are no cameras in the lab)."

For the *Password* condition, the following instructions were given: "This study is part of a research project on signatures. With the widespread use of computers, e-mail, and other electronic text-producing devices, people are often required to enter a password to access their personal accounts. As part of this research, we will ask you to imagine typing in your password onto a keyboard." The following sheet of paper contained the image of a QWERTY keyboard

and the instructions "Please go through the motion of entering your PASSWORD (there are no cameras in the lab)."

Results

Preliminary Analyses. As expected, the inclination to diverge was greater in preference domains that are more relevant to signaling one's identity ($\beta = 0.08$, $p < .001$), and the tendency to conform was lesser in those domains ($\beta = -0.12$, $p < .001$). Overall, participants identified closely with the in-groups they named ($M = 8.0$), felt similar to group members ($M = 7.3$), and liked group members ($M = 8.1$). ANOVAs reveal that each of these ratings varied across conditions (ps < .05). As compared to participants in the *Control* condition, those in the *Password* and *Sign Name* conditions identified more closely with the in-group ($M_{password} = 8.5$; $M_{sign.name} = 8.1$; $M_{control} = 7.6$, ps < .06), whereas those in the *PIN* condition did not ($M_{PIN} = 7.9$, $p = .14$). A similar pattern of results emerges for the measures of similarity and liking, such that individuals in the *Password* and condition reported feeling significantly more similar to the in-group than those in the control condition ($M_{password} = 7.9$; $M_{control} = 7.0$, $p < .05$), and reported liking group members more than those in the control condition ($M_{password} = 8.8$; $M_{control} = 7.5$, $p < .01$). By contrast, individuals in the *PIN* and *Sign Name* conditions did not significantly differ from those in the control condition in those measurements (ps > .12).

Hypothesis Tests. Our key prediction was that engaging in an identity-relevant motor action – such as entering one's password or PIN – would lead participants to make more identity-congruent choices. To test this prediction, we performed a mixed-effects logistic regression with choice of option A – indicating conformity – as the dependent variable and with each of the conditions (control vs. sign name vs. password vs. PIN), the identity-relevance score of the preference domain, and all possible interactions as independent variables, along with random

effects for participant and preference domain. For the purpose of these contrasts, we treated the control condition as the base condition. A significant main effect emerges for the sign name *treatment* ($P_{control}$ = 46%, $P_{sign.name}$ = 55%, β = 0.66, p < .05) and the *password* treatment ($P_{control}$ = 46%, $P_{sign.name}$ = 57%, β = 0.36, p = .05), and the main effect for the *PIN* treatment is marginally significant ($P_{control}$ = 46%, P_{PIN} = 53%, β = 0.36, p = .08).

Further exploration reveals that the effect of the *password* and *PIN* treatments on conformity is moderated by how closely each individual identifies with the in-group (interaction terms: βs > 0.34, ps < .05). Spotlight analyses reveal that entering a password or a PIN leads to greater conformity when participants identify closely with the in-group they named ($\beta_{password}$ = 0.87, β_{PIN} = 0.90, ps < .05), but not when participants do not identify closely with the in-group ($\beta_{password}$ = -0.55, β_{PIN} = -0.03, ps > .10). Although a similar pattern emerges for the *sign name* treatment, in that signing leads to significantly greater conformity at high levels of identification (β = 0.88, p < .05) but not at lower levels of identification (β = 0.35, p = .23), the interaction term is not significant (p = .13). Figure 4 illustrates the nature of the interplay between the conditions and closeness of identification.

Discussion

The results of study 3 indicates that two additional identity-relevant actions – typing one's password and entering one's PIN – may serve as general self-concept primes. Signing one's name, typing one's password, and entering one's PIN all lead individuals to conform more with an in-group, and this effect is stronger the more closely that one identifies with the in-group. This pattern of results is consistent with study 1 and study 2 of this paper, and with study 4 of Kettle and Häubl (2011a), in which a general self-concept prime led to greater conformity with an in-group.

GENERAL DISCUSSION

Consumers use a variety of means to verify their identity to others, each of which is important for functioning in modern society. They must sign their name to enter into contracts, type in a password to access e-mail and on-line banking, and use their PIN to conduct banking and make retail purchases. Despite the critical role of these means of identity verification in human economic life, little is known about whether, or how, verifying one's identity influences behavior. In three studies, we have shown that one's self-concept is primed by engagement in a set of behaviors with three essential properties: they must be (1) motor actions that (2) serve as a means of identity verification and (3) are unique to the individual.

The present research makes several key contributions to our understanding of consumer behavior. First, it extends recent work showing that signing one's name influences subsequent behavior in a predictable manner, in that it tests two behaviors that serve a similar function to signing one's name, and demonstrates that engagement in these behaviors – typing one's password and entering one's PIN – also serve as general self-concept primes. These findings enhance our understanding of the significance of the act of verifying one's identity, and suggest that the motor actions of producing one's signature, password, or PIN are associated with one's self-concept. Moreover, this work suggests two novel interventions that facilitate the general priming of one's self-concept (Dijksterhuis and van Knippenberg 2000; Hamilton and Shuminsky 1990; Smeesters et al. 2009).

Second, the present research contributes to the literature on embodied cognition by demonstrating that engagement in identity-relevant actions can serve to generally activate one's self-concept. Whereas prior work on the association between behavior and thoughts has focused on actions that are associated with particular stereotypes (Bargh, Chen, and Burrows 1996;

Mussweiler 2006), thought processes (Alibali and Spencer 2011; Koch, Holland, and van Knippenberg 2008) and constructs (Topolinski 2011; Zhong and Leonardelli 2008), the present work is the first to examine the essential properties of the set of behaviors that are generally associated with one's self-concept.

This article represents an important first step in determining the essential properties of identity-relevant interventions that serve as general self-concept primes. With the finding that the act of signing – but not viewing one's signature – acts as a general self-concept prime, this paper extends the finding of Kettle and Häubl (2011a) that printing one's name is not a general self-concept prime. These results support the self-action account of the signature effect, and suggest that engagement in identity-relevant motor actions may be necessary to generally prime one's self-concept.

This research also has important implications for on-line retailers, as it sheds new light on the influences of passwords and PINs on consumption-related behavior. Many online retailers and service providers give customers the choice between signing in (using a password or PIN) versus making a purchase as an unregistered guest. The results of study 3 suggest that signing in could influence consumers' behavior in a predictable manner, such that doing so would increase the engagement of consumers who associate their self-concept closely with the retailer or its products. For example, in line with the results of study 2 of Kettle and Häubl (2011a) that indicate that signing their name induces runners to spend more time in a running-themed store, signing in to the website of an online sports retailer should induce sports-oriented individuals to spend more time shopping on that website.

The present work suggests several directions for future research. First, although the results of study 3 indicate that entering passwords and PINs produce the same pattern of effects

as signing one's name, it is possible that they would produce different results in different situations. Whereas one's signature is not uniquely associated with a particular aspect of one's self-concept, one's password and/or PIN may be. For example, if an individual uses his profession as the inspiration for his password (e.g., "militaryman" if he is a soldier), then typing his password may exclusively activate that particular aspect of his self-concept, rather than serving as a general self-concept prime.

Finally, it would be worth examining how these interventions affect behavior within a consumption context. One limitation of the present work is that our interventions all involved blank pieces of paper in a task that was ostensibly unrelated to consumption. Although this ensured high internal validity of our findings, it did so at the expense of external validity. Future research should investigate how verifying one's identity by logging into a website or signing one's name interacts with the situation. For example, is behavior changed if one must log into a website to access its contents as compared to logging in to complete a purchase? Similarly, does entering a password to access a website for social purposes (e.g., logging into Facebook) versus consumption purposes moderate its effect on subsequent behavior?

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APPENDIX A. PREFERENCE DOMAINS

Domain	Identity-Relevance Score
Bike Light	1
Dish Soap	2
Detergent	3
Toothpaste	4
Power Tools	5
Stereo	6
Sofa	7
Backpack	8
Dinner Entrée	9
Sunglasses	10
Car Model	11
Favorite Actor	12
Car Brand	13
Jacket	14
Sitcom	15
Favorite CD	16
Music Artist	17
Hairstyle	18
Music Genre	19

FIGURE 1. CONFORMITY WITH (AND DIVERGENCE FROM) IN-GROUP AS A FUNCTION OF ENGAGEMENT IN MOTOR ACTION OF SIGNING ONE'S NAME AND CHRONIC NEED-FOR-UNIQUENESS (STUDY 1)

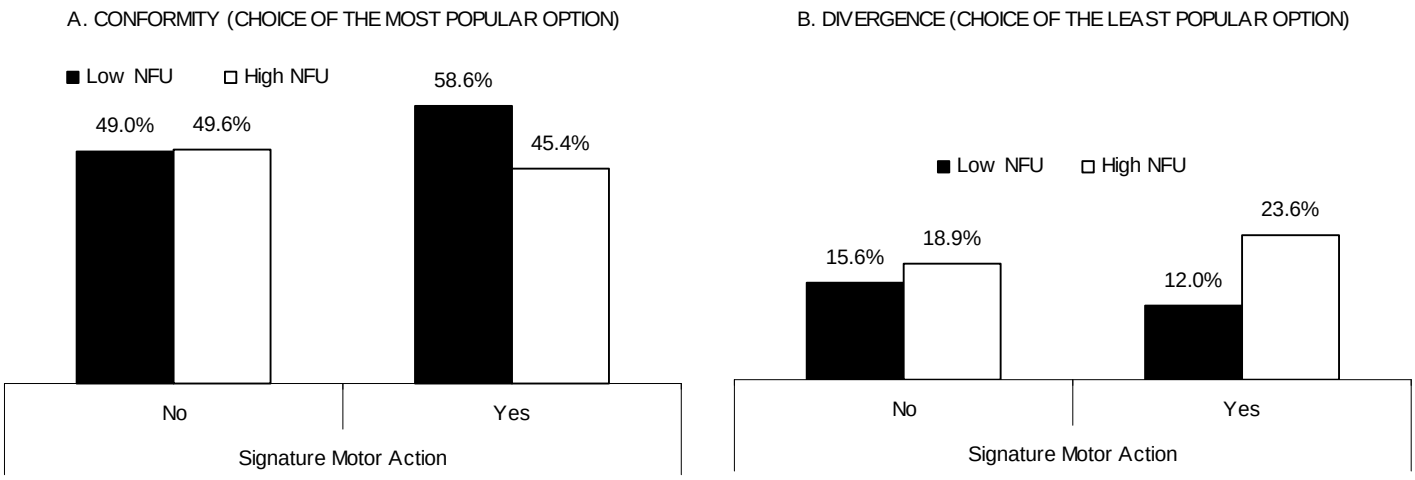


FIGURE 2. CONFORMITY WITH IN-GROUP (CHOICE OF THE MOST POPULAR OPTION) AS A FUNCTION OF ENGAGEMENT IN THE MOTOR ACTION OF SIGNING ONE'S NAME AND WHETHER THE SIGNATURE WAS VIEWED (STUDY 2)

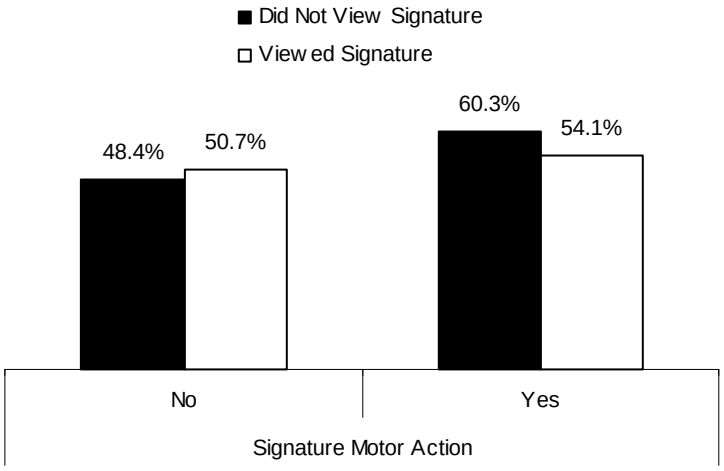
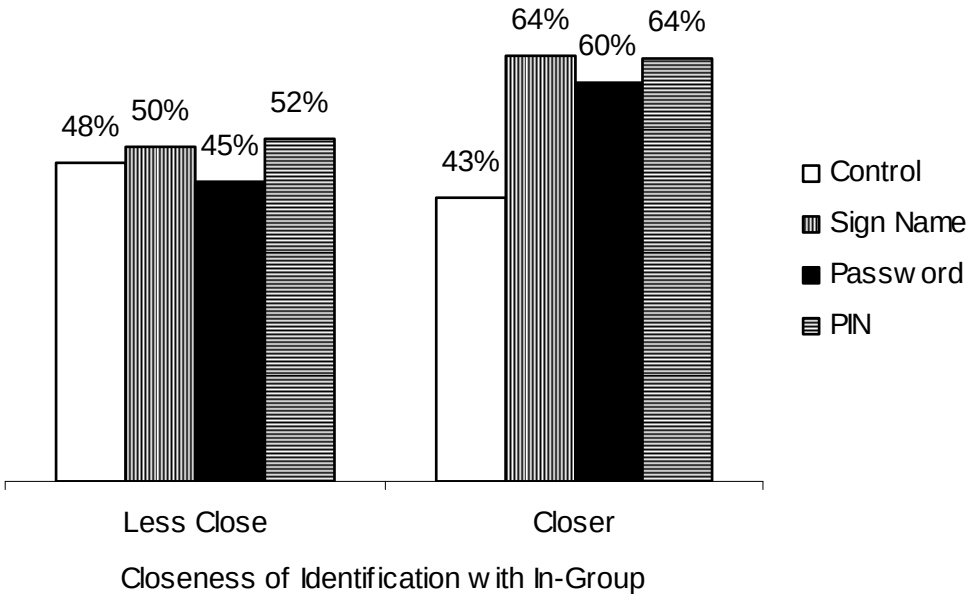


FIGURE 3. IMAGE OF QWERTY KEYBOARD AND PIN PAD (STUDY 3)

FIGURE 4. CONFORMITY WITH IN-GROUP AS A FUNCTION CONDITION AND CLOSENESS OF IDENTIFICATION (STUDY 3)



CHAPTER 5: CONCLUSION

What is a general self-concept prime? In this dissertation, I have defined a general self-concept prime as a single intervention that can activate multiple distinct aspects of one's self-concept. In this sense, the term "general" refers to the nature of the prime, not the nature of the self-concept. My view is that a general self-concept prime interacts with cues in the environment to activate the aspect(s) of one's self-concept that is (are) afforded by the present situation.

Results from the 11 studies reported in this dissertation are consistent with my conceptualization of the general self-concept prime. In the first essay, results from four studies indicate that signing one's name acts as a general self-concept prime (whereas printing one's name does not), that signing activates the aspect of one's self-concept that is relevant in the present situation, and that signing predictably influences behavior across a variety of situations, and for a variety of aspects of the self-concept. Although the first paper initially conceptualizes the effect of signing one's name as a "general self-identity prime," subsequent studies indicate that this family of effects is not just limited to aspects of one's self-identity, but also extends to the broader self-concept.

The second essay presents four studies that show that merely signing one's name predictably influences math performance by activating one's self-concept. Signing predictably moderates the relationship between one's (self-perceived) talent, yet is not affected by the difficulty of the math problems attempted and does not affect performance by activating one's attitudes toward math. This essay clearly indicates that a general self-concept prime does not spuriously activate identities, as the performance of senior undergraduate, graduate, and accounting female students is not hindered by the priming intervention, and also highlights some

potential public policy implications of the general self-concept prime. In a population in which there is a gender gap in self-perceived talent, having individuals sign their name before a math assessment broadens the gender gap in performance.

Essay 3 represents an important first step toward identifying the essential properties of interventions that serve as general self-concept primes. By decomposing the signature effect into its two constituent elements – the physical act of signing and viewing one's signature – studies 1 and 2 indicate that engagement in an identity-relevant behavior generally primes one's self-concept, but viewing an identity-relevant image (of one's signature) does not. Study 3 makes an initial foray into identifying other identity-relevant priming behaviors by showing that typing one's password and entering one's PIN produce behavioral effects that are consistent with the general self-concept prime.

Theoretical Contributions

The general self-concept prime is distinct from the (many) other priming interventions in the behavioral sciences. Generally speaking, behavioral researchers prime a specific identity or construct in order to observe its predictable effects on behavior. For instance, a scrambled-sentence task (SST) – in which individuals must create 4-word sentences from 5-word lists – is a popular means by which researchers enhance the accessibility of a particular construct. By amending the words present in the SST (e.g., replace "male" with "female"), a researcher can prime a particular identity (in this case, gender), and then infer (from subsequent behavior) what schemas are associated with the primed identity. A significant shortcoming of such interventions is that they fail to tap into the individual's true self-concept – in fact, they are known to prime the desired identity in individuals who do not possess that identity as part of their self-concept (Aronson et al., 1999; Bargh et al., 1996). As a result, use of these priming interventions may

thus lead to erroneous or overstated conclusions about the role that a particular identity or stereotype plays in individuals' behavior.

Take, for instance, the raft of research that explores the gender gap in math performance. That there exists a significant gap is beyond doubt. The exact role that the negative female gender stereotype plays in producing or broadening the gender gap, however, is much less certain. In order to assess the role of the gender stereotype, many researchers prime the female gender identity or the stereotype and observe subsequent performance and attitudes. In this domain, priming the female gender stereotype has been shown to produce contrasting effects in males and females: subtle interventions hinder the performance of females, but have no effect on the performance of males, whereas blatant interventions lead females to perform better, but lead males to perform worse (see, e.g., Aronson et al., 1999; Kiefer & Sekaquaptewa 2006, 2007; Shih et al., 1999). What remains absent from this literature is the ability to assess whether these individuals possess the female gender stereotype as an aspect of their self-concept *before* the stereotype-activating interventions.

A key theoretical contribution of this dissertation, therefore, is the identification of an intervention that activates one's true self-concept, rather than socially constructed identities and stereotypes. The modest interventions demonstrated in the present research stand in stark contrast to previous self-concept primes, which require participants to answer a lengthy set of self-relevant questions (Dijksterhuis and van Knippenberg 2000; Hamilton and Shuminsky 1990; Smeesters et al. 2009). Furthermore, the identification of a single intervention that activates different aspects of one's self-concept makes a novel contribution to priming literature, and to our understanding of the self-concept and associated behaviors.

Second, this dissertation makes a substantial contribution to the literature on embodied cognition. The present research demonstrates that engagement in identity-relevant actions can serve to generally activate one's self-concept, which suggests that a very large mental representation – one's entire self-concept – can be associated with a single identity-relevant action such as signing one's name. This is a major contribution in that prior work on the association between behavior and thoughts has focused on actions that are associated with particular constructs (Alibali and Spencer 2011; Bargh, Chen, and Burrows 1996; Koch, Holland, and van Knippenberg 2008; Mussweiler 2006; Topolinski 2011; Zhong and Leonardelli 2008). Furthermore, it contributes to recent work indicating that learned actions are associated with particular constructs, and can thus activate those constructs (Chandler and Schwarz 2009), by showing that a learned behavior can be associated with one's entire self-concept.

Third, the present research makes a novel contribution by examining three distinct means of verifying one's identity – signatures, passwords, and PINs – and showing that engaging in any of these means predictably influences one's behavior. This finding changes our understanding of the significance of the act of verifying one's identity, which other researchers have associated with commitment (e.g., Werner et al. 1995) and ethics (Shu et al. 2011). We show that engaging in these identity-relevant actions serves to prime one's self-concept. Our findings may account for these other findings, as signing one's name may activate one's self-concept as an ethical person (does anybody perceive themselves to be unethical?), and it may activate one's self-concept as a person who lives up to his/her commitments. A means of self-identification is always associated with one's identity, irrespective of the situation in which it is used.

Finally, this dissertation sheds new light on the role of the situation in prime-to-behavior effects by identifying conditions under which people are more or less responsive to identity-

relevant situational affordances. In contrast to prior work that has focused on the direct role that cues play in shaping consumption behavior (Berger and Fitzsimons 2008), this dissertation indicates that cues in the environment can play an indirect role in how they influence people's thoughts and behavior across different situations.

Future Research

This dissertation represents a significant first step in developing a comprehensive theory of the general self-concept prime, and suggests several avenues for the development of a comprehensive research program in this regard. I will highlight three key areas for future research.

First, there remains much work to be done to identify the broader set of interventions that may serve as general self-concept primes. Results from eleven studies clearly demonstrate that signing one's name acts as a general self-concept prime, as does typing one's password and entering one's PIN, but that printing one's name or viewing one's signature do not. To this point, I have made the assumption that one's signature, password, and PIN are associated with one's self-concept, thus permitting the general priming of the self by engagement in the motor action of producing these unique identifiers. Longitudinal studies of these identity-relevant actions would shed light onto their essential properties. For instance, one could study recently married females who must change their signature when they change their last name; signing should not act as a general self-concept prime until they associate their revised signature with their self-identity.

This pattern of results suggests that engagement in identity-relevant motor actions serves to generally prime one's self-concept. Consistent with this theorizing, typing one's password and entering one's PIN influence behavior in a manner that is consistent with the general priming

of one's self-concept. However, it is possible that passwords and PINs are actually associated with a specific aspect of one's self-concept (e.g., a social identity), and that the paradigm used in study 3 of essay 3 afforded that particular identity. For instance, if one's password is derived from the name of a social group to which one belongs, then typing that password may differentially activate that group, thus leading to behavior that is similar to a general self-concept prime in the context of identity-signaling. Future research should examine passwords and PINs more closely to determine whether they produce the same pattern of effects as signing one's name.

Second, the exact nature of the prime-to-behavior effects of a general self-concept prime need to be explored more fully. Although the results presented in this dissertation suggest that a general self-concept prime produces assimilation effects (i.e., behavior that is congruent with the relevant aspect of one's self-concept), results from study 4 of essay 2 hint at the possibility that a general self-concept prime may produce contrast effects. Specifically, female participants who were shown a preview of a math problem performed worse if they had not previously signed their name, but actually performed better if they had signed. One possible explanation for this pattern of results is that the general self-concept prime heightened their sensitivity to the preview; without a signature, the preview was a subtle prime, but with the signature it became a blatant prime, thereby inducing reactance. Although it is also possible that this contrast effect was spurious, results from another study on the effect of signing on food consumption produces a similar pattern of results. Thus, future research should examine the conditions in which a general self-concept prime generates assimilation versus contrast effects.

Finally, it would be worth examining how the context in which one identifies oneself affects behavior. One limitation of the present work is that the general self-concept prime was

always presented in a task that was ostensibly unrelated to consumption. This ensured high internal validity of our findings by clearly isolating the identity-relevant action, but it did so at the expense of external validity. Future research should investigate how the nature of the action interacts with the act of verifying one's identity. For example, is the signature effect diminished or enhanced when consumers sign important documents such as mortgage agreements? Similarly, does using one's password to log in to a consumption website (e.g., to purchase an airline ticket) versus a non consumption-related website (e.g., facebook) moderate its effect on subsequent behavior? Because consumers must verify their identity in many contexts, it is important to develop a deeper understanding of how doing so influences behavior.

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