Group-based science rejection:

How social identities shape the way we perceive, evaluate, and engage with science

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1 Introduction

Does anthropogenic climate change exist and should I therefore try to reduce my CO_2 emissions? Is homeopathy effective and should I make use of it? Are violent video games harmful and should my children play these games? Science is potentially the best source to give answers to these questions and we often seek advice in scientific findings in order to make effective everyday decisions. Concerning these questions, scientific evidence would indicate that anthropogenic climate change exists (e.g., Intergovernmental Panel on Climate Change, 2007), homeopathy only has a placebo effect (e.g., Shang et al., 2005) and violent video games can have aggression-enhancing effects (e.g., C. A. Anderson et al., 2010; Greitemeyer & Mugge, 2014). However, using scientific information to answer personally relevant questions does not happen in a vacuum: all of these findings also directly relate to our everyday rationalities and subjective experiences and these rationalities and experiences may affect our perception and evaluation of the scientific information at hand. For example, one might have observed that the winters got milder over the years, that homeopathy did not help when one was ill or that one's children were more agitated after playing violent video games. In these instances, our own impressions confirm the scientific evidence and there is no need to be skeptical toward science. However, what happens when we have made contradicting observations and experiences? When scientific findings collide with our own experiences, we are tempted to question the validity of the research and sometimes even reject them rather than questioning our own point of view (Ditto & Lopez, 1992; Kunda, 1990).

Rejecting scientific evidence only because it collides with our opinions and experiences might affect our ability to make effective everyday decisions. For instance, when parents dismiss evidence demonstrating the harmfulness of violent video games and allow their children to play these games, their children may become more agitated and aggressive. Likewise, when people reject evidence on the non-effectiveness of homeopathic medicine, they may spend money on non-effective medicine that could have been used for effective medicine. One might argue that we all occasionally dismiss and reject valid scientific

evidence and that this does not constitute a major societal problem. It is true that negative societal consequences of individuals rejecting scientific evidence are often remote, but this changes drastically when entire social or societal groups dismiss scientific evidence as invalid. Rejection of scientific evidence by large or influential social and societal groups may have profound negative consequences for science itself but also for our society as a whole. Science needs the public's support. It can only progress when the public trusts and values its achievements. Only when the public perceives science as contributing to societies' wealth by providing sound and helpful answers to ecological, economic, and social problems, science can legitimate itself in our society and receive continuous funding. In addition, rejecting scientific findings that tackle societal problems hinders positive societal change. Scientific findings can only unfold a positive, progressive societal influence when policy makers consider them as valid and base their decisions upon them. However, policy makers may become reluctant to do so when a substantial number of people to whom they are accountable in democratic societies reject and devalue these findings. Hence, when parts of the public deny the existence of anthropogenic climate change, energy saving policies may be impeded, when powerful interest groups reject evidence demonstrating the ineffectiveness of homeopathy, precious resources in our health systems may be wasted and when the public dismisses evidence demonstrating an aggression-enhancing violent-games-effect, legal age restrictions for violent video games might be lowered.

Science rejection based upon group membership (or social affiliations) may therefore have profound negative societal consequences. In this context, the question arises why group members would reject scientific evidence? Many scientific findings have consequences for social and societal groups to whom we may feel connected. For instance, research demonstrating that a vegan diet has adverse health effects (e.g., Craig, 2009) has immediate implications for the group of vegans, research on the harmfulness of violent video games (e.g., C. A. Anderson et al., 2010) has implications for video game players and research on

potentially adverse effects of unions on economic growth (e.g., Nickell & Layard, 1999) has implications for unionists. Social identity theory postulates that group members are motivated to see their in-group positively and they derive a portion of their self-worth – their *social identity* – from positive evaluations of their group (Tajfel & Turner, 1979, 1986). Any information endangering this positive sense of one's social identity leads group members to question the validity of the information (Wood, 2000). Notably, our social affiliations are also the most important motivators for taking organized collective action (Louis, 2009; Van Zomeren, Postmes, & Spears, 2008; Wright, Taylor, & Moghaddam, 1990). Scientific findings jeopardizing a positive aspect of our social identity might therefore not only trigger a cognitive devaluation but also collective behavioral resistance. Thus, our social identity may constitute a major obstacle for an objective and fair assessment of group-relevant scientific findings and, more importantly, might actually result in collective action against these findings.

Group-based action against social identity threatening scientific findings might also set the stage for a broad societal devaluation of these findings: group members might start disseminating their science-discrediting opinion. Nowadays, this can easily be done on the Internet. For instance, video game players may feel threatened by research confirming the violent-games-effect hypothesis and may publicly and collectively decry this research as invalid by posting science-discrediting comments on a news site. When social and societal groups dismiss scientific findings and proclaim this publicly, other members of the public might be persuaded to also reject the respective scientific evidence (A. A. Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014; Kareklas, Muehling, & Weber, in press; Metzger, Flanagin, & Medders, 2010). Thus, social identity threatening scientific findings should have an increased risk of being opposed by larger parts of the public and not only by separate individuals. Notably, in recent controversially led science-based debates, the public's devaluation of scientific evidence was often driven by social and societal groups: republicans

publically rejected research demonstrating anthropogenic climate change, physicians practicing alternative medicine decried research demonstrating its ineffectiveness and video game players devalued research demonstrating the harmfulness of violent video games. Identifying factors promoting a group-based misperception and rejection of science is therefore of great interest for a democratic society as a whole and for science itself in particular.

The present thesis investigates factors promoting a group-based science rejection. Basing this thesis on the social identity theory (Tajfel & Turner, 1979, 1986) and research on collective action (Van Zomeren et al., 2008), I argue that when scientific research findings explicitly or implicitly threaten people's need for a positive social identity, people misperceive, devalue, and take action against these findings in order to reestablish their social identity. Therefore, this thesis sets out to integrate research on social identity with research on science communication in order to explain laypersons' reactions to group-relevant research findings. In the following, I first present previous findings on laypersons' science reception concentrating on how it is influenced by science knowledge and personal motivations (1.1), offer theoretical explanations for laypersons' science rejection (1.2) and derive the conceptual basis for group-based science rejection effects (1.3).

1.1 Psychological Factors Influencing Laypersons' Science Reception

Research on laypersons' science rejection has identified several factors that influence laypersons' science attitudes. A public knowledge deficit was and is sometimes still regarded as the most important reason for laypersons rejecting scientific evidence ("deficit model of public understanding of science"; see Bauer, 2012). Because of the prominence of this hypothesis in science communication research and since it is often used as a landmark to contrast recent (psychological) findings to, I will briefly present evidence on this hypothesis first (1.1.1). However, inspired by social-psychological research on motivated reasoning (cf.

Kunda, 1990), science communication research recently began to consider how motivations, more specifically laypersons' goals, also affect their science reception. This research on a motivated reception of scientific evidence (cf. Gollwitzer, Rothmund, Klimmt, Nauroth, & Bender, 2014) is particularly important for the phenomenon of a group-based science rejection and can also be seen as a conceptual opposite pole of the deficit model and is therefore presented next (1.1.2). Besides motivations and knowledge, other factors also influence how laypersons deal with scientific evidence, as, for example, epistemic cognitions and beliefs (e.g., Bromme, Kienhues, & Porsch, 2010; Sinatra, Kienhues, & Hofer, 2014) or general trust in scientists (Cummings, 2014). Even though these factors are also important when drawing a comprehensive picture of laypersons' science reception in general, they are not directly relevant for the present research and are therefore not reviewed.

1.1.1 Knowledge

One reason why laypersons sometimes reject scientific findings may be rooted in the division of cognitive labor (Keil, 2010). The rapid growth of scientific knowledge is accompanied by an increasing differentiation of knowledge in many scientific fields that leads to a distribution of knowledge across highly specialized experts. Thus, one inherent feature of laypersons' understanding of science is that their knowledge invariably differs from experts' knowledge concerning scientific issues ("bounded understanding of science", see Bromme & Goldman, 2014). We are all laypersons with regard to most scientific knowledge domains and an intuitively appealing approach aligning laypersons' assessment of a scientific state-of-the-art with experts' assessment is to simply increase public's knowledge about science.

The deficit model views the public's rejection of science as underpinned by this lack of knowledge (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008). Laypersons' rejection of evidence concerning anthropogenic climate change, ineffectiveness of homeopathy or the detrimental effects of violent video games would be reduced if laypersons were better able to

understand the scientific concepts upon which the evidence is based. The notion that a knowledge deficit may be responsible for negative attitudes towards science is supported by a fair amount of empirical evidence (e.g., Bauer, Petkova, & Boyadjieva, 2000; Evans & Durant, 1995; Hayes & Tariq, 2000; Sturgis & Allum, 2004). In a meta-analysis conducted by Allum et al. (2008), more knowledge about science in general predicted positive attitudes toward science. Across 193 studies, they showed a robust but small positive correlation (r = .08) between "textbook" scientific knowledge and favorability of attitudes toward science.

In addition to its empirical support, an asset of the deficit model is that it offers clear and immediate recommendations on how to enhance the public's attitudes toward science: in order to remedy the public's misperception and rejection of science, more science needs to be taught in schools and also to be communicated to the public. Because of its conceptual parsimony, its intuitive appeal, and its clear cut recommendations, many practical science communication initiatives were informed by the deficit model and it is still the predominant model in populate science (see Bubela et al., 2009; Evans & Durant, 1995; Gross, 2006).

Nonetheless, the deficit model has several theoretical shortcomings and faces many contradicting empirical findings. First, the effect of general "textbook" knowledge on attitudes towards specific science domains (e.g., regarding environmental science) is considerably smaller than toward science in general and even zero regarding controversial science domains (e.g., research on genetically modified food; see Allum et al., 2008; Bak, 2001). Second, the confirmatory evidence concerning the deficit model mainly comes from cross-sectional survey studies and the causality implied by the deficit model therefore has not strictly been tested yet. Third, even though the parsimony of the deficit model is one of its assets, it is also its major theoretical weakness: it neither postulates any mediating processes explaining *why* knowledge should affect attitudes (and not vice versa), nor does it consider any individual or social variables potentially moderating the knowledge-attitude relationship.

Importantly, a large body of psychological research on motivated reasoning challenges the preconception of the deficit model that people are blank slates waiting to be filled with facts leading to changes in attitudes and behavior. This line of research shows that personal motivations profoundly influence laypersons' science reception and that knowledge is only one determinant of laypersons' science reception.

1.1.2 Motivations

Assuming that knowledge is not the most influential, let alone the only, determinant of the public's perceptions and attitudes toward a specific science domain, which other factors might be influential? Particularly in socio-scientific issues, people are not blank slates, but have prior attitudes, values, or beliefs connected to the issue (for reasons of simplicity I will use the term "belief system" to encompass all relevant beliefs, values, and attitudes of a person concerning a given issue). For instance, some people might condemn violent video games without having been confronted with any research investigating the effects of violent video games. These people might base their stance toward violent video games upon their moral values condemning any kind of violence (Maier, Rothmund, Retzbach, Otto, & Besley, 2014). Thus, when these people read about scientific evidence refuting the violent-games-effect hypothesis, they might be tempted to disapprove of this research because it contradicts their prior belief system (Rothmund, Bender, Nauroth, & Gollwitzer, submitted). Indeed, research on motivated reasoning demonstrated that one's prior belief system profoundly biases individuals' information processing (Kunda, 1990; Lord, Ross, & Lepper, 1979). When confronted with persuasive information, our belief system influences how we cognitively construct (Lodge & Taber, 2000) and how we evaluate the information (Ditto, Scepansky, Munro, Apanovitch, & Lockhart, 1998). For instance, when the content of a persuasive message contradicts pre-existing attitudes, individuals are motivated to put forth extra effort to refute this information, for example, by spending more time to recall knowledge contradicting the information (Redlawsk, 2002).

Applying these findings to laypersons' science reception, recent research showed that long-held values, beliefs, and attitudes also profoundly influence how people deal with scientific findings. For instance, laypersons have more negative attitudes toward nanotechnology when it stands in contrast to their religious beliefs (Brossard, Scheufele, Kim, & Lewenstein, 2009; Scheufele, Corley, Shih, Dalrymple, & Ho, 2009). Research on the violent video games debate demonstrated that belief-contradicting scientific evidence leads laypersons to evaluate the evidence more negatively and to become more certain of their prior point of view (Greitemeyer, 2014): people believing that violent video games (do not) have detrimental effects evaluate research refuting (confirming) the violent-games-effect hypothesis as less convincing and to be less replicable in future studies compared to research confirming (refuting) the violent games effect hypothesis. Confronting people with research findings that are inconsistent with their prior beliefs even sparks fundamentally critical attitudes toward science in general, such that people argue that a particular topic cannot be studied scientifically at all (Munro, 2010). Concerning research on climate change, cultural worldviews like individualism (Kahan et al., 2012; Kahan, Jenkins-Smith, & Braman, 2011) and political ideologies like free market beliefs (Heath & Gifford, 2006; Lewandowsky, Gignac, & Oberauer, 2013; Lewandowsky, Gignac, & Vaughan, 2012) have been shown to predict a rejection of scientific evidence demonstrating the existence of anthropogenic climate change. For instance, Heath and Gifford (2006) showed that free market believers dismiss scientific evidence presumably because it implies implementing market restrictions (like energy saving policies) contradicting their view of an unregulated economy. Taken together, these findings show that the personal belief systems profoundly influence laypersons' science reception.

These findings constitute the empirical basis for the notion of a motivated science reception. That is, laypersons' reactions to scientific findings are being shaped by whether the findings are discrepant or concordant to their personal goals and motives. Even though all

these effects nicely demonstrate this phenomenon, they do not offer a theoretical explanation of why people process belief-contradicting evidence in a biased manner.

1.2 Psychological Explanations for Laypersons' Science Rejection

The reviewed research successfully identified several psychological factors leading to the rejection of scientific evidence. However, to date, psychological mechanisms underlying this science rejection have not been identified. One reason for this might be a lack of integrating theorizing and a highly fragmented theoretical basis. More precisely, science rejection triggered by religious beliefs (Scheufele et al., 2009) is based upon conceptualizing religious beliefs as "perceptual filters" (Brossard et al., 2009), science rejection triggered by cultural values is derived from the "cultural cognition hypothesis" (Kahan, Braman, Monahan, Callahan, & Peters, 2010), science rejection triggered by non-religious beliefs (Greitemeyer, 2014; Lord et al., 1979) is often explained by cognitive dissonance theory (Festinger, 1957; Huesmann & Taylor, 2003), science rejection triggered by political ideologies by reference to system-justification theory (Feygina, Jost, & Goldsmith, 2010), and some findings do not even refer – at least not explicitly – to a clear theoretical basis (e.g., on conspiracy beliefs, see Lewandowsky, Oberauer, & Gignac, 2013). However, the common denominator of these effects is that laypersons reject science that conflicts with their belief system. Reconsidering the effects from this point of view, dissonance theory (Festinger, 1957) is often proposed (e.g., Huesmann & Taylor, 2003) as a prominent social-psychological theory potentially being able to explain these effects.

1.2.1 Dissonance Theory

Cognitive dissonance theory (Festinger, 1957; Festinger & Carlsmith, 1959) is probably the most prominent theory explaining the rejection of belief-inconsistent information. Cognitive dissonance describes an aversive state of arousal produced when cognitions (or behaviors, or emotions) stand in contrast to each other. In the terminology of

dissonance theory, cognitions encompass values, attitudes, and beliefs (thus, the entire belief system). When experiencing dissonance the individual is motivated to reduce this dissonance.

Concerning belief-inconsistent scientific findings, the two most relevant strategies how individuals could resolve dissonance are that they either reject the respective findings as invalid or change their initial belief (cf. Festinger, 1957). Since people are reluctant to change initial beliefs (see Kunda, 1990), they should be particularly prone to reject belief-inconsistent scientific findings as demonstrated in the aforementioned evidence on science rejection effects (1.1.2). Even though dissonance theory is apparently able to explain science rejection effects, it faces problems concerning its proposed underlying mechanism (i.e., dissonance reduction as a goal of science rejection). Steele (1975) demonstrated that in order to reduce the negative state of arousal when confronted with belief-inconsistent information, individuals do not necessarily have to reject the information nor do they have to change their initial belief. Rather, affirming alternative sources of one's self-worth (i.e., "self-affirmation") also leads to decreased defensiveness concerning belief-inconsistent information. He formalized his reasoning in the self-affirmation theory (Steele, 1988).

1.2.2 Self-Affirmation Theory

Self-affirmation theory suggests that defensiveness toward belief-contradicting information can be attributed to the motivation of having an overall positive self-concept (Steele, 1988). People want to feel good about themselves and therefore prefer information that is consistent with their belief system (Kunda & Sanitioso, 1989). According to self-affirmation theory, evidence that challenges our belief system is perceived as threatening insofar as adjusting or even abandoning cherished beliefs would entail losing a source of esteem or identity (Cohen, Aronson, & Steele, 2000). That is, belief-contradicting evidence *threatens* the integrity of our self-concept. To cope with this threat, we are tempted to process such evidence defensively (Ditto & Lopez, 1992). The motivation to protect our self-concept

against disconfirming evidence is often referred to as an *ego-defense motivation* (Chaiken, Giner-Sorolla, Chen, Gollwitzer, & Bargh, 1996).

In contrast to dissonance theory, self-affirmation theory introduced people's self-concept as necessary theoretical tenet for understanding people's defensiveness to belief-contradicting information. Dissonance theory assumes a defense motivation to be aimed at restoring consistency, whereas self-affirmation theory assumes it to be ego-protective (Steele, 1988). Consequently, self-affirmation proposes that affirming alternative sources of one's self-worth (i.e., "self-affirmation") satisfies the ego-protection motive. In contrast, dissonance theory does not assume that heightening self-worth in one domain leads to reduced dissonance in another (Cohen et al., 2000). Indeed, a large body of empirical evidence confirmed the effectiveness of self-affirmation (Sherman & Cohen, 2006). In a recent meta-analysis conducted over 144 experimental studies concerning health-related persuasive information, a self-affirmation had small effects ($.17 \leq d\text{s} \leq .32$; depending on outcome variable) reducing a biased assimilation of belief-disconfirming information (Epton, Harris, Kane, van Koningsbruggen, & Sheeran, 2015). Thus, self-affirmation theory seems to describe the underlying mechanisms more accurately when individuals are confronted with belief-disconfirming evidence than dissonance theory does.

Interpreting the phenomenon of science rejection from a self-affirmation perspective, people dismiss, reject, and devalue scientific evidence that directly or indirectly contradicts their belief system in order to protect the integrity of their self-concept. Affirming alternative domains of one's self-concept should reduce a biased assimilation of research findings. Self-affirmation theory therefore offers an integrative theoretical framework for research on science rejection particularly when scientific evidence has consequences for our *personal* self-concept made up of attitudes, beliefs and values. However, scientific evidence sometimes does not primarily challenge the personal belief system, but rather affects the evaluations of

social categories and groups to which people feel to belong (i.e., an in-group). For instance, research demonstrating that men hold sexist attitudes against women (Glick et al., 2000) negatively affects the societal evaluations of the group of men since sexist attitudes are socially undesirable. Research having negative implications for in-groups might therefore also be perceived and evaluated in a way buffering negative consequences for one's *social* self-concept. However, self-affirmation theory – at least in its original form (Steele, 1988) – does not make explicit predictions about how people react upon threats aiming at their social self-concept. In its advancements, self-affirmation theory started to emphasize the importance of social identities for the awareness of who one is and found that self-affirmation can also buffer social identity threats (Sherman & Kim, 2005). More recently, Sherman, Kinias, Major, Kim, and Prenovost (2007) conceptually extended self-affirmation theory in order to also explicitly cover defensiveness toward group-relevant information by heavily drawing upon social identity theory (Tajfel & Turner, 1979, 1986).

Extending self-affirmation theory with elements from social identity theory is only consequential: both theories share the basic principle that people want to maintain a positive sense of self. However, simply transferring theoretical and empirical insights from the individual level to the group level may be premature since theorizing about group-based aspects of self and identity also necessitates considering group characteristics and processes (for a discussion see Ellemers, Spears, & Doosje, 2002). In contrast to self-affirmation theory, social identity theory makes distinct predictions about how group members react to information directly or indirectly affecting evaluations of an in-group. In this regard, social identity theory is superior to self-affirmation theory because it explicitly models additional group-based processes and can draw upon a rich body of literature that already investigated how individuals react to threats to one's social identity. As put forward in the beginning, social identities may play an important role in people's understanding and engagement with

science and I therefore continue by briefly describing the basic tenets of social identity theory relevant for research on laypersons' science reception.

1.2.3 Social Identity Theory

According to social identity theory (Tajfel & Turner, 1979, 1986), a portion of our self-concept is derived from our affiliations to social groups (i.e., our *social identity*). In contrast, our personal self-concept (i.e., our *personal identity*) refers to people's self-definition as unique and different from others (e.g., our belief system). Like self-affirmation theory, social identity theory posits that individuals strive to maintain and enhance a positive self-concept. Furthermore, social identity theory assumes that social categories and groups are associated with positive or negative social and societal evaluations. Since our social identity is defined by our social affiliations, the positivity of our self-concept is also determined by these evaluations. Therefore, persuasive information affecting our in-group evaluations also affects our overall self-worth and negative evaluations of a worshipped in-group lead to a motivation to reestablish a positive social identity. In the terminology of social identity theory, a jeopardized positivity of one's social identity is defined as a *social identity threat*, and a jeopardized positivity of one's personal identity as a *personal identity threat.*

From these basic tenets, Tajfel and Turner (1979, 1986) derived a set of predictions for intergroup behaviors that laid the basis for a very rich literature on intergroup relations (for an overview see, e.g., Brown, 2000). However, these principles also have important implications for intragroup processes (Postmes & Jetten, 2006) as well as for social information processing (Abrams & Hogg, 1999). Deriving predictions regarding laypersons' science reception from these basic tenets, one could argue that when scientific evidence negatively affects laypersons' in-group evaluations, laypersons feel threatened in their social identity.

Reactions to a Social Identity Threat

People have different strategies to defend themselves against a social identity threat. In general, people may either leave an existing group to escape the negative implication for their self-concept or they may strive to make their group more positively distinct (Tajfel & Turner, 1986). Positive distinctiveness can be achieved by either redefining or altering the dimension on which the threat occurred (referred to as "social creativity") or by challenging the threat (referred to as "social competition" or "social change"). Both of these strategies are *identity enhancing*, since they aim at restoring an impaired social identity. For instance, emphasizing positive attributes of a group is a form of social creativity (Glasford, Dovidio, & Pratto, 2009; Sherman et al., 2007), whereas taking collective action against a threat is a form of social competition (Van Zomeren et al., 2008).

These general predictions were specified by Branscombe, Ellemers, Spears, and Doosje (1999). These authors distinguished four different types of social identity threats: acceptance (undermining one's position within the group), categorization (being categorized as group member against one's will), distinctiveness (group distinctiveness is prevented or undermined), and value (group's value is undermined). Since negative implications for one's social identity emanating from scientific findings are most often value relevant, that is, research findings associate the in-group to a negative attribute (e.g., being aggressive, unhealthy, unintelligent, unsuccessful…), and thereby jeopardize positive feelings about the in-group, I will focus on this type of threat here. For instance, research demonstrating that men have a better spatial ability (as a facet of intelligence) than women (e.g., Lawton, 2010), implicitly describes women as less intelligent than men. Likewise, research showing an aggressive-enhancing effect of violent video games (e.g., C. A. Anderson et al., 2010) implicitly describes video game players as aggressive. According to Branscombe et al. (1999), threatening one's in-group's value leads in-group members to react defensively and derogatively: value-relevant social identity threats have been shown to increase the likelihood

of (a) processing the threatening information defensively (De Hoog, 2013), (b) defensive-hostile reactions against the source of the threat (Twenge, Baumeister, Tice, & Stucke, 2001), and (c) taking collective action against the threat (Biernat & Dovidio, 2000).

In sum, according to social identity theory, laypersons should react to research threatening their social identity in a derogative and defensive manner. This reaction should be motivated by a desire to protect their social identity – and not their personal identity. However, the intensity of the reaction to a social identity threat heavily depends on the degree of identification with the in-group.

The Moderating Role of Social Identification

Social identity theory posits that people differ in their importance of a group membership for their social self-concept, that is, they differ in their *social identification* (Tajfel, 1978). People who feel strongly connected and attached to a group, base a larger portion of their self-concept on positive connotations of this group (Ellemers, Spears, & Doosje, 1997). The more strongly people identify with a group, the stronger their motivation to maintain a positive social identity by being a member of this category (Tajfel & Turner, 1979, 1986), particularly after it was threatened (Glasford et al., 2009). Notably, in order for social identity to unfold an influence, a certain degree of identification is necessary (Tajfel, 1978). For instance, a black person for whom being black is not important at all, that is, his/her identification being very weak, is rather unlikely to act based upon his/her social identity of being black, even in intergroup situations (see e.g., Ashmore, Deaux, & McLaughlin-Volpe, 2004). Consequently, social identification was shown to moderate a whole range of social identity effects (e.g., Bendersky, 2014; Branscombe et al., 1999; Derks, Van Laar, & Ellemers, 2006, 2009; Leach et al., 2008; Postmes, Haslam, & Jans, 2013; Sherman et al., 2007; Van Zomeren et al., 2008). For instance, since strong identifiers' self-concept is more heavily based on their group membership than weak identifiers', they are also

more likely to react in a defensive-hostile manner upon a social identity threat (Scheepers, Spears, Doosje, & Manstead, 2003) and to process threatening information defensively (De Hoog, 2013). This should also apply to laypersons' reaction to threatening scientific evidence: laypersons strongly identifying with a group and being confronted with group-threatening research findings should be particularly prone to devalue and reject the respective findings.

In sum, social identity threat and social identification are the two most important concepts of social identity theory when investigating laypersons' science reception from a social identity perspective. Threatening individuals' social identity triggers defensive processing of the threatening information and derogative behavior toward the source of the threat. These reactions should be particularly pronounced for group members for whom the in-group is very important – that is, for those who strongly identify with the in-group. The present research is the first to apply these predictions to laypersons' science reception. To date, virtually no research addressed the question whether and how research findings threatening the social identity of laypersons bias laypersons' reaction to the respective research findings. This is remarkable since distinct predictions can be derived from the research on social identity theory regarding how laypersons react toward research findings that threaten their social identity. Notably, these predictions are not restricted to evaluations – the prime focus in prior research on science rejection – but also have implications for perceptions and behavioral reactions.

1.3 The Present Research

The present research aims to extend our understanding and knowledge about laypersons' assessment of and engagement with science in two ways. First, it conceptually extends research on the public's understanding of science with theoretical inputs from social identity theory. Second, it widens the focus of prior science rejection research by also investigating laypersons' perceptions of and behaviors toward science. The central notion of

the present research is that when scientific research programs and empirical findings threaten laypersons' social identity, laypersons perceive, evaluate and engage with this research in a defensive-hostile manner in order to maintain a positive social identity (*group-based science rejection*). In the following, I briefly present the consequences of this hypothesis on laypersons' reactions on three levels: evaluations, behaviors, and perceptions.

1.3.1 Evaluations

Individuals' assessment of persuasive information as trustworthy and valid is heavily influenced by their group affiliations (Wood, 2000). When people are confronted with negative information about a group with which they strongly identify, they experience a social identity threat that triggers a biased information processing in a manner favorably for their social identity. For instance, Dietz-Uhler (1999) showed that students who identified strongly with their university evaluated a report describing their university negatively more critically than a positive report (for similar findings see also Cadinu & Cerchioni, 2001). More recently, Hartmann and Tanis (2013) showed that group members perceive newspaper articles as biased against their in-group when they identify strongly with the in-group. De Hoog (2013) argued that these effects can be conceptualized as an instance of defensive processing. In her study, women read social identity threatening texts including negative statements about their gender group or describing the unequal pay of women compared to men. These texts lead to a higher perceived threat, longer reading time, more defensive thoughts (i.e., criticizing or counter arguing) and more negative evaluations of the texts (as being one-sided and unfair) compared to neutral and positive texts. Threat perceptions and defensive thoughts mediated the effect of text type on text evaluation.

Even though these findings support the notion that strong identifiers show defensive processing of threatening information, the reasoning that defensive processing is triggered by a threat to the *social* self may be premature. The threat manipulations employed by de Hoog

(2013) may not only have threatened the social identity but almost certainly also the personal identity. Positive beliefs about the in-group (e.g., “woman are competent”) and social identification with the in-group are often inherently confounded: the more strongly individuals identify with the group the more positive are also their attitudes toward the in-group (e.g., Ashmore et al., 2004). In de Hoog’s study, social identification with the group of women should predict the degree to which participants also believed that women are more competent than men are. Thus, when strong-identifiers are confronted with negative statements about attributes of their in-group, it also threatens their personal identity by being inconsistent with their personal beliefs about their in-group. Thus, it cannot be answered conclusively whether the observed defensive processing was triggered by social identity concerns or by belief-inconsistency. This concern is enhanced by the fact that de Hoog (2013) measured threat (as the proposed mediator) only on an individual (“I feel threatened by this text”) and not on a collective level (e.g., “This text threatens my identity of being a woman”). Unfortunately, other research investigating the effect of social identification on a biased evaluation also suffers from similar shortcomings (i.e., Cadinu & Cerchioni, 2001; Dietz-Uhler, 1999; Hartmann & Tanis, 2013).

In sum, when group members read information describing their in-group negatively, they may process this information defensively because this information most often also jeopardizes personal beliefs and not exclusively the positivity of their group membership. In other words, whereas the former process would be more parsimoniously described by self-affirmation theory, only the latter supports the social identity perspective. Even though it is theoretically reasonable to assume that strongly identified group members process social identity threatening information defensively, a proper empirical test of this assumption is still missing. Investigating a biased evaluation triggered by social identity relevant information is therefore not only interesting for science communication research, but also theoretically relevant for social identity research itself. In order to be able to convincingly argue that a

social identity threatening research finding triggers a negative evaluation of the respective finding, personal identity alternative explanations, as discussed above, have to be ruled out. In the present research, this was addressed by (1) statistically controlling for relevant confounding personal identity variables (i.e., personal beliefs and behavioral habits in Manuscript #1), (2) by investigating group-based mediators (i.e., group stigmatization in Manuscript #1 and social identity affirming vs. personal identity affirming strategies in Manuscript #2), and (3) by experimentally manipulating group membership (i.e., in a minimal group paradigm in Manuscript #3).

1.3.2 Behaviors

According to social identity theory, threats to one's social self may not only bias our information processing but also motivate people to act against the threat. For instance, Scheepers et al. (2003) showed that strongly identified soccer fans reacted upon a social identity threat (e.g., a goal against their team) by intoning insulting songs against the other team. Intoning derogative songs was regarded as serving the function of motivating other in-group members for collective action against the other team. Similarly, in a comprehensive meta-analysis, Van Zomeren et al. (2008) provided evidence that social identification with a disadvantaged group predicts collective action. Based upon these findings, one could argue that social identity threat emanating from science might also motivate group-members to take collective action against the threatening scientific findings. Interestingly, virtually no research has investigated which factors promote such negative collective engagements with science yet. It also remains to be asked what such collective action against scientific findings could look like. Nowadays it is easier than ever before for laypersons to comment on and to engage with science via the Internet. It is also easier than ever for motivated laypersons to discredit disliked science publicly, namely, by writing a science-discrediting comment on a news site or a blog presenting scientific research findings. Importantly, these negative comments can

also persuade other readers to dismiss the findings as invalid (A. A. Anderson et al., 2014; Kareklas et al., in press; Metzger et al., 2010).

From a conceptual perspective, writing online comments for the sake of one's in-group is a form of "low-threshold" online collective action. Low-threshold (i.e., low-risk, low-cost) online collective actions describe, for example, joining and liking a group's Facebook page, signing online petitions and posting comments, whereas high-threshold (i.e., high-risk, high-cost) online collective actions refer to "hacktivism" or establishing and maintaining a protest website (Van Laer & Van Aelst, 2010). Involvement in low-threshold online collective actions was actually shown to predict engagement in higher-threshold online and offline collective actions like e-mail campaigning or participating in discussion sessions (Vaccari et al., 2015). In other words, low-threshold collective actions may also set the ground for a broad public devaluation of science. The present research investigates whether social identity threatening science indeed triggers science-discrediting behavior on the Web and whether this behavior serves an identity enhancing function (Manuscript #2).

1.3.3 Perceptions

Besides affecting information processing and behavior, our social identity also alters the perception of social identity threatening out-groups (Ellemers et al., 2002; Spears et al., 1999). When scientists publish research findings that have negative consequences for one's social identity, laypersons' may shield their social identity from these negative consequences not only by altering their evaluations and communication about the research, but also by altering their perception of the respective researchers. Interestingly, research on social identity theory and group perception proposes two contradicting processes by which laypersons may change their perception of researchers who publish threatening research findings (Manuscript #3): laypersons may either alter their homogeneity perception of the entire scientific

community (“homogeneity hypothesis”) or their typicality perception of the researchers publishing threatening findings (“subtyping hypothesis”).

The homogeneity hypothesis adopts a genuine inter-group perspective. It rests on the assumption that laypersons perceive researchers publishing research findings as prototypes of the group of scientists and infer attributes and characteristics from the authors to the entire scientific community. Group perception research demonstrated that negative behaviors are particularly likely to be generalized from an out-group member to the entire out-group (Barlow et al., 2012; Stark, Flache, & Veenstra, 2013). This implies that when researchers publish threatening findings (a “negative” behavior for in-group members), group members may infer that the entire group of scientists is threatening for their in-group. Furthermore, in-group members perceive threatening out-groups as rather homogeneous (Dépret & Fiske, 1999; Rothgerber, 1997; Wilder, 1978). Thus, according to the homogeneity hypothesis, being confronted with researchers publishing threatening research findings should lead to increased homogeneity perceptions of the respective scientific community.

By contrast, the subtyping hypothesis focuses more strongly on identity regulation processes. It argues that people may shield their social identity from negative consequences by perceiving the social identity threatening researchers as not being “real” scientists. The process of categorically excluding out-group members from their out-group is described as subtyping (Weber & Crocker, 1983). Laypersons may cope with a threat emanating from scientific evidence by dismissing a single threatening finding as exceptional and perceiving the publishing researchers as dissenting and non-representative. Accordingly, researchers who published the threatening finding may not be perceived as a part of the group of scientists anymore. The key variable indicating subtyping is perceived prototypicality (Richards & Hewstone, 2001). Thus, if the subtyping hypothesis was true, laypersons should perceive

researchers publishing threatening research findings as less typical members of the group of scientists.

Both hypotheses have immediate consequences for how competent and reputable researchers might be perceived. According to the subtyping hypothesis, laypersons should perceive researchers publishing threatening research findings as incompetent and disreputable in line with the decreased typicality perception. Conversely, it follows from the homogeneity hypothesis that threatening research findings affect neither competence nor reputation. Hence, investigating these two competing hypotheses offers insights into how laypersons' perceptions of scientists are formed and which consequences these perceptions have for the publishing researchers and for the scientific community as a whole.

2 Summaries of the Manuscripts

The present thesis is based on seven studies that are presented in three Manuscripts. Manuscript #1 (Studies 1, 2, and 3) focused on disentangling personal identity and social identity explanations for a biased evaluation of threatening research results and on the mediating processes explaining a biased evaluation. Manuscript #1 investigated laypersons' reception of research findings in the context of the violent video games debate with participants being video game players ("gamers"). Study 1 ($N = 347$) used a correlational design to examine the relationship between social identification and a biased evaluation of threatening research. Participants' identification with the group of gamers was measured as the group-based predictor of a biased evaluation. In order to control for personal identity alternative explanations participants' belief in negative effects of violent video games ("effect beliefs" indicating a belief-inconsistency effect) and their violent video games habits ("gaming habits" indicating a behavioral preference inconsistency effect) were also assessed. For instance, one could argue that strongly identified gamers are prone to devalue threatening research findings because they simply believe that violent video games are harmless or to protect a valued hobby. Participants read a description of the field of research on violent video games explicitly mentioning that researchers aim to investigate the aggression-enhancing effects of these games. This subtle reference served as the threat induction. As expected social identification with the group of gamers predicted negative evaluations of the field of research even when controlling for effect beliefs and gaming habits. Furthermore, this effect was mediated by perceived stigmatization.

Studies 2 and 3 experimentally replicated the findings from Study 1 by manipulating whether participants read a study confirming the violent-games-effect hypothesis ("harm-confirming" study) or confuting this hypothesis ("harm-disconfirming" study). The harm-confirming study should be threatening for gamers' social identity and the harm-disconfirming study should not be threatening. Whereas Study 2 focused on the mediating processes of a biased evaluation, Study 3 more stringently ruled out alternative explanations

and additionally investigated whether gamers generalize their evaluations of a single study to the entire field of violent video games research. In Study 2 ($N = 97$) anger about the study was measured as an additional personal identity mediator besides perceived stigmatization. As expected, strong identifiers evaluated the harm-confirming study more negatively than weak identifiers and this was not the case for the harm-disconfirming finding. This effect was again mediated by perceived stigmatization and additionally by anger about the finding. Study 3 ($N = 199$) investigated whether the biased evaluation of research findings observed in strong identifiers is confounded by effect beliefs and gaming habits. Results showed that neither gaming habits nor effect beliefs predicted a negative evaluation of the harm-confirming study with identification being the only significant predictor. Furthermore, the results of Study 3 show that gamers generalized their evaluation of the harm-confirming study to the entire field of research on violent video games. In sum, all three studies in Manuscript #1 consistently show that social identity threatening research findings trigger a biased assimilation of research findings, that this effect is mediated by group-based perceptions (i.e., stigmatization) and independent from personal identity alternative explanations (i.e., gaming habits and effect beliefs).

Manuscript #2 (Studies 4, 5, and 6) focused on behavioral responses toward a social identity threatening research finding and again investigated laypersons' science reception within the violent video games debate. Study 4 ($N = 84$) used a correlational design to examine the relationship between gamers' assessment of the current state of research concerning the effects of violent video games and identification with the group of gamers and self-reported posting behavior. As expected, strong identifiers reported to post a comment more often than weak identifiers when they perceived the current state of research confirming the violent-games-effect hypothesis. Study 5 ($N = 655$) used an experimental and methodologically more sophisticated design to replicate and extend the results obtained in Study 4: participants could actually post a negative and/or a positive comment in a simulated

science blog environment. Results show that strong identifiers were more likely (than weak identifiers) to write science-discrediting comments against a harm-confirming study and that this effect was mirrored in more negative evaluations. Content analysis of the posted comments revealed that strong identifiers particularly criticized the methodology of the confirmatory study. The goal of Study 6 ($N = 459$) was to demonstrate that writing science-discrediting comments against social identity threatening research results is motivated by the desire to reestablish the jeopardized social identity. For this purpose, participants were either self-affirmed, collectively affirmed or not affirmed after reading a harm-confirming study. As predicted, strong identifiers' (compared to weak identifiers') likelihood to write a science-discrediting comment was reduced after being collectively affirmed and this was not the case when being self-affirmed. Taken together, all three studies in Manuscript #2 consistently show that social identity threatening research findings not only trigger a biased evaluation but also lead to behavioral resistance aiming at discrediting a social identity threatening finding.

Manuscripts #3 (Study 7) extends the findings from Manuscript #1 and #2 by focusing on laypersons' perceptions of scientists. The goal of Study 7 ($N = 138$) was to test the homogeneity hypothesis against the subtyping hypothesis. In contrast to the former studies, Study 7 did not investigate laypersons' science reception within the violent games debate but employed a minimal group paradigm thereby strengthening the generalizability of the findings. Furthermore, reactions to identity affirming scientific findings were also investigated. Participants were ostensibly categorized as exhibiting a "holistic association style" and were confronted with either a social identity threatening, affirming or neutral (as control condition) research finding. Results show that whereas in-group affirming and threatening scientific findings (compared to the control condition) alter laypersons' (a) evaluations of the respective study, only in-group threatening findings alter laypersons' (b) perceptions of a scientist's typicality and (c) assumptions regarding the scientist's competence and reputation. More precisely, in-group affirming findings lead to more positive evaluations

and threatening findings to more negative evaluations. However, scientists were perceived as less prototypical, less competent, and less reputable only when their research finding was threatening for participants' social identity. These results favor the subtyping hypothesis concerning threatening research findings and demonstrate that the effect of social identity threatening research also changes laypersons' perception of the respective researchers.

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Research article

Gamers against science: The case of the violent video games debate

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Abstract

This article explores the notion that scientific research programs and empirical findings are fundamentally devalued when they threaten a perceiver's social identity. Findings from three studies show the following: (1) identification with the group of "gamers" (i.e., people who play video games on a regular basis) influences the extent to which perceivers devalue research suggesting that playing violent video games has negative consequences; (2) this effect is mediated by the feeling that the group of gamers is being stigmatized by such research (Studies 1 and 2) as well as by anger about this research (Study 2); (3) the effect of in-group identification on negative research evaluations cannot be explained by attitude or behavioral preference inconsistency (Studies 1 and 3); and (4) strongly identified gamers not only devalue a specific scientific study but also generalize their negative evaluations to the entire field of violent video games research (Study 3). The findings suggest that the influence of social identity processes on the evaluation of research is larger than it has previously been recognized. Implications of these findings for science communication are discussed. Copyright © 2013 John Wiley & Sons, Ltd.

- *This is total **** And I know Im backed up by the millions of gamers out there!*
- *If u say video games influences teens behaviors u are f***ing ignorant. I shoot mother f***ers on call of duty all day and i would not do a school shooting.*
- *As a gamer, I should know, I have never met anyone who had violent behavior from a V[ideo] G[ame]. …*[1]

In most societies, scientific research is funded by public money. The public can therefore expect scientists to provide answers to what they think are important and societally relevant questions. Scientists are supposed to contribute to understanding, describing, explaining, predicting, and solving technical, economic, political, or social problems. Especially in the domain of social sciences (e.g., sociology, psychology, education, and criminology), ordinary people usually feel more confident to subjectively evaluate the quality of scientific research, as social scientific findings are often strongly connected to people's everyday rationality (Flyvbjerg, 2001; Haslam & Bryman, 1994).

Research on science communication has shown that public evaluations of scientific reports are influenced and affected by recipients' prior beliefs (Scheufele, Corley, Shih, Dalrymple, & Ho, 2008), prior attitudes (Munro, 2010), prior knowledge (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008), or interactions of these factors (Ho, Brossard, & Scheufele, 2008). For example, people have a more critical stance toward nanotechnology when it contradicts their religious beliefs (Brossard, Scheufele, Kim, & Lewenstein, 2008). Moreover, people holding hierarchical-individual values perceive global warming as not dangerous and, therefore, devalue research findings that demonstrate the negative consequences of global warming. On the contrary, people holding egalitarian-communitarian values perceive global warming as dangerous and therefore devalue research showing no adverse effects of global warming (Kahan, Braman, Slovic, Gastil, & Cohen, 2008; Kahan, Jenkins-Smith, & Braman, 2011). More recent research shows that accepting versus rejecting scientific findings, such as the facts that HIV causes AIDS and that smoking causes lung cancer, is associated with conspiracy beliefs (Lewandowsky, Oberauer, & Gignac, 2013). Being confronted with research findings that are inconsistent with one's prior beliefs even sparks fundamentally critical attitudes toward science in general, such that people argue that a particular topic cannot be studied scientifically (Munro, 2010). Taken together, these findings show that attitudes and values held individually or derived from a social or cultural affiliation (e.g., Kahan et al., 2011) influence how laypersons evaluate scientific findings and how they "engage" with science in their daily lives.

The statements quoted at the beginning of this article display a particular way of "engaging" with science. They illustrate how members of a particular group (in this case, people who play violent video games on a regular basis, henceforth referred to as "gamers" for reasons of simplicity) disregard and even disqualify scientific research suggesting that playing violent

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[1]Gamers' comments on the question of whether violent video games contribute to youth violence. Retrieved 23 January 2013, from http://videogames.procon.org

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video games can have detrimental social or developmental effects. One might argue that devaluing research reflects a form of motivated reasoning on an individual level (cf. Ditto & Lopez, 1992; Kunda, 1990). In the context of the violent video games debate, such motivated reasoning biases might reflect two forms of inconsistencies: First, gamers like and play these games and therefore oppose any statement that sheds a bad light on these games. Thus, research that might ultimately result in sales bans or accessibility restrictions is devalued because it collides with gamers' *behavioral preferences* (i.e., their gaming habits). Second, video game players who hold a positive attitude toward violent video games and do not believe in any negative effects might disfavor research that contradicts these beliefs. In other words, such research might be devalued because it is inconsistent with gamers' prior *attitudes*.

In the present article, we argue that these individual-level explanations cover only a part of the picture. We hypothesize that identification with a group is sufficient to trigger a biased evaluation of group-relevant scientific findings and that devaluing scientific research on the detrimental effects of playing violent video games can thus be better explained by *group-based* processes: Being a gamer also implies belonging to a social category, and the stronger a person's identification with that category, the stronger one's motivation to maintain a positive social identity by being a member of this category (Tajfel & Turner, 1979, 1986). From a social identity perspective, empirical research reporting detrimental effects of playing violent video games threatens gamers' positive social identity: Such findings imply a stigmatization of the group of gamers. Fundamentally criticizing such research can therefore be conceptualized as a form of "collective action" to defend the group's image and one's social identity (e.g., Van Zomeren, Postmes, & Spears, 2008).

GAMERS AS A SOCIAL CATEGORY

Gaming has become increasingly popular over the last decades (Williams, Yee, & Caplan, 2008). With an increased dispersal of online games over the Internet, people are now able to connect and play with and against each other in real time. These developments have contributed to a growing community of people who consider themselves as "gamers." Because each game has its own fans, game-specific subcommunities have emerged in which gamers frequently communicate with each other and meet in the virtual or even real world. Besides sharing their gaming habits, gamers also commit and contribute to common activities: They are active in lobby groups (e.g., the "Video Game Voters" or "Gamers against Rejection"[2]), they organize common events (e.g., trade fairs such as the E3 or Gamescom), and they share a common (sub)culture, which is mainly defined in terms of common social practices and a shared identity created in the gamespace (Taylor, 2006). Thus, there is reason to expect that gamers constitute a visible social category and that people differ in the extent to which they perceive themselves to belong to this category.

[2]See https://secure.videogamevoters.org or http://www.digitale-generation.de (retrieved 23 January 2013).

Perceiving oneself as a member of a group creates the basis for group identification processes, which influence the way individuals interpret group-relevant information (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). The question of whether or not playing violent video games has detrimental effects is highly identity relevant for gamers. Folk wisdom has associated heavy gaming with acts of intensive violence, such as school shootings and cruel murders (e.g., Ferguson, 2008). The stigmatization of gamers in the public discourse constitutes an intergroup context in which the social category of being a gamer becomes salient whenever the question about potentially harmful effects of playing violent video games is discussed. Accordingly, we argue that social factors should be considered in order to understand the dynamics and emotionality of gamers' reactions toward research on the effects of violent video games.

When an intergroup context is salient, an individual's reaction toward persuasive information is heavily influenced by the in-group's position toward this information (Cohen, 2003; Wood, 2000). In the field of gender differences, Morton, Haslam, Postmes, and Ryan (2006) demonstrated that a scientific study was more positively evaluated when it affirmed participants' gender identity. When a scientific study portrayed their own gender group in a positive light, participants considered the study to be "scientific" and were more interested in this research. The authors concluded that scientific findings are more likely to be perceived as credible and plausible to the extent that they provide people with a positive sense of identity, irrespective of the actual scientific state of the art. Research on social identity processes suggests that such effects should be particularly pronounced among individuals who strongly identify with their respective group (e.g., Ellemers, Spears, & Doosje, 1997). For example, Jetten, Spears, and Manstead (1997) demonstrated that strongly identified group members are more likely to behave in accordance with salient group norms than weakly identified group members. Regarding gamers' evaluation of research on the effects of violent media, we therefore assume that strongly identified gamers are more likely to reject and devalue such research (to the extent that this research constitutes a social identity threat) than weakly identified gamers.

CONSEQUENCES OF SOCIAL IDENTITY THREAT

When people strongly identify with their in-group and when an intergroup context is salient, their behaviors are more strongly shaped by their social self than by their personal self (Turner et al., 1987). For example, being a strongly identified member of a problematized social group goes along with increased perceived stigmatization (Major & O'Brien, 2005; Major, Quinton, & Schmader, 2003). In our case, if a scientific study corroborates an aggression-enhancing effect of violent video games, people who strongly identify with the group of gamers should feel more strongly stigmatized by such research than weakly identified gamers. Furthermore, perceived stigmatization increases the likelihood for defensive-hostile reactions against the source of that stigmatization (Twenge, Baumeister, Tice, & Stucke, 2001) and is assumed to increase the likelihood for collective action (Biernat & Dovidio, 2000). In other words,

perceived stigmatization can mediate the effect of threat on defensive and hostile reactions toward the source of that threat.

Besides perceived stigmatization, people who strongly identify with a group facing an identity threat also experience more negative emotions (Ellemers, Spears, & Doosje, 2002; McCoy & Major, 2003; Van Zomeren, Spears, & Leach, 2008) such as anger or moral outrage. Furthermore, anger has been found to mediate the effect of threat on (collective) action tendencies (Leach, Iyer, & Pedersen, 2006, 2007; van Zomeren et al., 2008). Because strongly identified individuals who experience a threat to their social identity are also more likely to show aggressive reactions toward the source of that threat (Branscombe & Wann, 1992), there is reason to assume that anger explains not only collective action tendencies but also aggressive reactions—such as devaluing the source of that threat.

ALTERNATIVE EXPLANATIONS

Besides these social factors derived from social identity theory and research on collective action, individual factors might also account for a biased evaluation of research findings. For example, strongly identified gamers might simply believe that violent video games are harmless. In this case, the negative evaluation of scientific findings by strongly identified gamers might merely reflect an attitude inconsistency effect (Lord, Ross, & Lepper, 1979; Munro, 2010) instead of an instance of "collective action." Another alternative explanation could be that identification with the group of gamers is strongly associated with the habit of playing violent video games. Thus, people who like and regularly play these games might fear that research showing a media violence effect might ultimately lead to sales bans or accessibility restrictions. In other words, research demonstrating that playing violent video games has harmful effects collides with gamers' behavioral preferences. Notably, it is theoretically possible that people devalue scientific evidence showing negative effects of a certain behavior (such as gaming) even though they acknowledge that such behavior can have negative effects. In line with this argument, Weinstein (1998) reported that smokers do indeed acknowledge that smoking has negative effects. However, at the same time, smokers tend to evaluate scientific information demonstrating negative effects of smoking as less credible than nonsmokers do. In a similar vein, gamers might acknowledge that playing violent video games can have negative effects, but they might still discredit scientific studies demonstrating these effects. Taken together, one might argue that the effect of social identification on the biased evaluation of scientific results merely reflects a behavioral preference inconsistency effect and/or an attitude inconsistency effect. However, we argue that social identification with the group of gamers can lead to a biased evaluation of scientific findings over and above such individual-level effects.

HYPOTHESES AND RESEARCH GOALS

The present article describes three studies designed to test three hypotheses: The *first* hypothesis is that one's identification with the group of gamers predicts a biased evaluation of scientific research findings (i.e., a fundamentally negative evaluation of findings demonstrating detrimental effects of playing violent video games) and of the entire area of media effects research (Studies 1, 2, and 3). The *second* hypothesis is that this effect is mediated by perceived stigmatization and anger (Studies 1 and 2). The *third* hypothesis is that identification has a unique effect on the biased evaluation of scientific findings over and above one's personal effect beliefs about violent video games (i.e., attitude inconsistency) or one's gaming habits (i.e., behavioral preference inconsistency; Studies 1 and 3).

STUDY 1

Study 1 provides a first test of the hypothesis that the extent to which people identify with the group of gamers positively predicts harsh and fundamentally critical attitudes toward research that empirically corroborates the violent-games-effect hypothesis and that this relation is mediated by perceived stigmatization. Additionally, Study 1 was designed to test whether the two aforementioned alternative explanations, that is, effect beliefs about violent video games and gaming habits, can account for the hypothesized effect.

Method

Participants

In all, 561 undergraduate students from various disciplines (56.5% women) participated in mass testing sessions. Two hundred and fourteen participants (i.e., 38.1%) were excluded from further analyses because they indicated that they have not played any video games during the last 12 months ($n = 205$) or had more than 25% missing values on one or more scales ($n = 9$). Therefore, the final sample consisted of 347 participants (32.6% women). Ages ranged between 18 and 50 years ($M = 23.15$; $SD = 3.81$).

Materials and Measures

A correlational design was used to examine the relationship between identification with the group of gamers and a biased evaluation of scientific research findings.

Negative evaluations. First, participants read a short description of how researchers investigate the effects of violent video games (APPENDIX). The description explicitly mentioned that researchers aim to investigate the *aggression-enhancing* effects of violent video games; according to our hypotheses, strongly identified gamers should even regard such a subtle description as a threat to their social identity. Next, participants evaluated the entire area of research on the effects of violent video games and the respective researchers using a 10-item scale ("I think the results of this research can be meaningfully applied to real-life contexts" (recoded), "…these researchers are sometimes not very competent," "…the results of this research are unambiguous" (recoded), "…these researchers just find what they want to find," "…this research yields reliable

results" (recoded), "…this research yields important results" (recoded), "…scientists who do research in this field are often biased," "…one can draw useful conclusions for the real life from this kind of research" (recoded), "…this kind of research is not very meaningful," and "…the methodology is fundamentally useless to investigate the effects of violent video games"; Cronbach's $\alpha = .87$).

Effect beliefs were measured by asking participants to what extent they think that violent video games increase versus decrease the following: (1) aggressive thoughts; (2) aggressive dispositions; and (3) hostile tendencies (Cronbach's $\alpha = .77$). The items were presented together with three items indicating positive effects of video games in order to reduce demand effects. Ratings were obtained on a 7-point scale (−3 = *decrease*, 0 = *no effect*, 3 = *increase*). Thus, positive values indicate a belief in the detrimental effects of violent video games.

Gaming habits. Participants were asked whether they had played any video games during the last 12 months, and, if so, how many hours per week they usually spend playing each of eight different video game genres (i.e., "shooter" and battle games, role-playing games, strategy games, racing or sport games, massively multiplayer online role-playing games, skill games and jump'n'runs, simulation, or browser games). These genres had been pretested by experts on violent video games (15 students of computer science with extensive experience in playing video games) on a 6-point scale (0 = *no violent content*, 5 = *strong violent content*). The intraclass correlation was .72 across the 15 raters. A violence frequency index was computed by multiplying the time spent playing each category with the violence rating for that category (for a similar approach, see Anderson et al., 2008; Möller & Krahé, 2009).

Perceived stigmatization of the group of gamers was measured with a two-item scale ("People who regularly play video games are often devalued in the public" and "The public takes a one-sided stance toward people who regularly play video games;" Cronbach's $\alpha = .67$). Ratings were obtained on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*).

Identification with the group of gamers was measured with four items ("Being a 'gamer' is an important part of my identity," "Being a 'gamer' gives me a good feeling," "Being a 'gamer' is an important part of how I see myself," and "I feel connected with other 'gamers'"; Cronbach's $\alpha = .91$). Ratings were obtained on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*).

Finally, demographic information was assessed. Completing the questionnaire took about 10 minutes. One MP3 player was raffled among all participants who completed the survey. Descriptive statistics and correlations between all variables are displayed in Table 1.

Results

Negative Evaluations

According to our reasoning, strongly identified gamers should be more prone to discredit research and the researchers pursuing negative effects of violent video games. In line with our first hypothesis, identification with the group of gamers was positively related to a fundamentally negative evaluations of such research, $r = .33$, $p < .001$ (Table 1). However, gaming habits and effect beliefs were also significantly correlated with negative evaluations as well as with identification. Importantly, the effect of identification was still significant after controlling for gaming habits and effect beliefs, $B = 0.14$, $SE(B) = 0.04$, $p < .001$ (Table 2). Additionally, only effect beliefs also significantly predicted negative evaluations, whereas gaming habits did not. Thus, Hypotheses 1 and 3 were supported.

Perceived Stigmatization

We expected that the effect of identification would be mediated by perceived stigmatization of the group of gamers (Hypothesis 2). This hypothesis was tested with a mediation model (Figure 1). The indirect effect of identification via perceived stigmatization on negative evaluations was tested by inspecting bias-corrected 95% confidence intervals (CIs) obtained by bootstrapping using Hayes' (2013) PROCESS macro (5000 resamples). Even though the identification

Table 2. Results of multiple regression analyses (Study 1)

Predictor variables	Model 1 (DV: negative evaluations)	Model 2 (DV: perceived stigmatization)	Model 3 (DV: negative evaluations)
Constant term	5.268	4.015	4.777
Gaming habits	0.002	−0.006	0.002
Effect beliefs	−0.359***	−0.063	−0.351***
Identification with the group of gamers	0.14***	0.225***	0.113**
Perceived stigmatization	—	—	0.122**
R^2	0.208	0.084	0.227

Note: $N = 347$. DV, dependent variable. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 1. Descriptive statistics and correlations between variables in Study 1

Variable	*M* (*SD*)	Correlations (1)	(2)	(3)	(4)	(5)
Gaming habits (1)	11.19 (20.72)	1.00				
Effect beliefs (2)	0.44 (0.81)	−0.21***				
Identification with the group of gamers (3)	2.28 (1.29)	0.46***	−0.31***			
Perceived stigmatization (4)	4.24 (1.05)	0.13*	−0.13*	0.29***		
Negative evaluations (5)	4.02 (0.90)	0.21***	−0.40***	0.33***	0.24***	

Note: $N = 347$. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

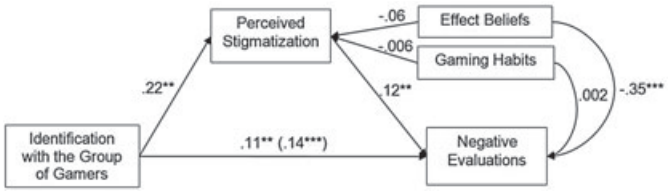

Figure 1. Mediation model (Study 1). $N = 347$. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

effect on negative evaluations was still significant after controlling for perceived stigmatization, the indirect effect was significant, $B = 0.03$, $SE(B) = 0.01$, 95% CI [0.01, 0.06], irrespective of whether or not gaming habits and effect beliefs were controlled for (indirect effect including covariates: $B = 0.03$, $SE(B) = 0.01$, 95% CI [0.01, 0.06]). In other words, perceived stigmatization partially mediated the effect of identification on negative evaluations under social identity threat, even when controlling for gaming habits and effect beliefs (Figure 1).

Discussion

The results of Study 1 provide first evidence for our notion that the evaluation of research findings is influenced by the degree to which gamers identify with their in-group and that this bias is fueled by a perceived stigmatization of the in-group. Notably, the effect of in-group identification (and the indirect effect of identification on negative evaluations via stigmatization) existed over and above gaming habits and effect beliefs. These findings support our hypothesis that potentially threatening research findings trigger harsh and fundamentally negative attitudes toward the respective research and the researchers and that this is particularly the case for strongly identified gamers.

Even though the results of Study 1 generally support our predictions, there are some limitations and shortcomings. Firstly, one should note the generally low levels of social identification with the group of gamers in our sample ($M = 2.28$ on a scale from 1 to 6). Secondly, we used a rather subtle threat induction. Possibly, our effects would have been even stronger if the mean and the variance of identification scores had been higher in our sample and the threat induction had been stronger. Thirdly, all of our participants were students, which might limit the generalizability of our results. Fourthly, the stigmatization items were rather unspecific. A more specific measure of stigmatization, pointing to the perception that gamers are stigmatized particularly by scientific research on the negative effects of playing violent video games, might have been better suited in order to address our hypothesis.

Finally and most importantly, we did not implement a control group (i.e., an experimental condition in which a nonthreatening research program is described). Thus, we do not know whether the effect of identification necessarily depends upon a social identity threat. Possibly, strongly identified gamers evaluate research on the effects of violent video games more negatively regardless of its implications for the in-group. Thus, Studies 2 and 3 used an experimental approach in order to strengthen the internal validity and to replicate the biased evaluation effect. Additionally, we used non-student samples in order to increase the generalizability of our results.

STUDY 2

Study 2 aims at replicating the effect of identification and its mediation via perceived stigmatization on biased evaluations of scientific research with a stronger design and a more specific stigmatization measure. Additionally, this study was designed to illuminate the underlying mechanisms of this bias in more detail. Besides perceived stigmatization, anger has been identified as an important mediator in explaining aggressive actions toward the source of a social identity threat (Branscombe & Wann, 1992) and collective action tendencies (e.g., Leach et al., 2007). Thus, it seems reasonable to assume that strongly identified gamers might not only feel stigmatized as a group but also feel angry about research demonstrating that playing violent video games can have detrimental effects. Hence, Study 2 provides a test of the hypothesis that anger might be a driving force in the negative evaluation of potentially threatening research besides a perceived stigmatization.

Method

Design and Procedure

Study 2 used data from an online-based experimental survey. Measures were assessed at two occasions with an interval of 2 weeks between them in order to reduce carryover effects. At Time 1, identification with the group of gamers was measured. At Time 2, participants were confronted with a short text summarizing the findings of a published study on the effects of playing violent video games. Depending on experimental conditions, this study was said to either corroborate or refute a violent games effect. Afterwards, participants' reactions toward the particular study and its authors were assessed.

Participants

Data were collected with the help of a professional sampling agency. This agency has access to a large participant pool available for marketing research and online surveys. Participants can be sampled from this pool on the basis of multiple —usually demographic—criteria. In our case, no particular sampling criteria were applied. On the first page of the survey, participants were asked to indicate whether they play video games on a regular basis (yes/no). Because we were specifically interested in *gamers*' reactions to science on violent video games, only those who indicated playing video games regularly were allowed to start the survey. In all, 548 participants responded to the invitation; 361 (48.6% women) of them indicated playing video games regularly and were directed to the survey. The other 187 were thanked and redirected to the agency site. Of those who started the survey, 350 (97%) completed it successfully. As suggested by Paolacci, Chandler, and Ipeirotis (2010) and by Oppenheimer, Meyvis, and Davidenko (2009), the survey also comprised an attention test ("If I complete this questionnaire attentively and focused, I check a 'three' here"). Participants who failed this test ($n = 67$) or had missing values on more than 25% of the items on the identification measure ($n = 1$) were omitted from all further analyses; this reduced the number of cases to 282 (47.9% women).

Completing this first survey took about 9 minutes; participants were rewarded with a raffle ticket worth 1800 "credit points" (approximately US$0.58).

Two weeks later, the same 282 individuals were invited to take part in a second survey on "consumer attitudes." Of those, 201 (71%) followed the invitation and started the survey, of which 183 (91%) finished the questionnaire. Data from the two measurement occasions were matched on the basis of a personalized code. Again, we included attention tests, and those who failed these tests ($n = 85$) and had missing values on 25% of the items within any scale ($n = 1$) were excluded from all subsequent data analyses.[3] Thus, the total dataset consisted of 97 cases (49.5% women). Ages ranged between 18 and 75 years ($M = 43.0$; $SD = 13.15$). Completing this survey took about 11 minutes; participants were rewarded with a raffle ticket worth 1800 "credit points" (approximately US$0.58).

Materials and Measures

At Time 1, demographic information as well as participants' *identification* with the group of gamers were measured with five items ("I feel solidarity with other 'gamers'," "I feel committed to the group of 'gamers'," "I am glad to be a 'gamer'," "I think that 'gamers' have a lot to be proud of," and "It is nice to be a 'gamer'."). Additionally, we included one item to measure identification with the group of gamers on a broader level adapted from Postmes, Haslam, and Jans (2013) ("I identify with the group of 'gamers'"). All items loaded on one factor and constituted a reliable scale (Cronbach's $\alpha = .88$). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*).

At Time 2, participants were first confronted with a short text summarizing the results from a published study on the effects of playing violent video games. Participants were randomly assigned to either a "harmful" (i.e., the study shows that violent games *do* increase aggressive tendencies; the study described here was taken from Anderson & Dill, 2000, Study 2) or a "harmless" (i.e., the study shows that violent video games do *not* increase aggressive tendencies; the study described here was taken from Ferguson et al., 2008, Study 1) condition. Importantly, identification with the group of gamers did not reliably differ between the two conditions, $t(95) = 0.65$, $p = .52$. The summary read as follows ("harmless" condition in brackets):

> In an experiment conducted by Craig Anderson and colleagues [Christopher Ferguson and colleagues] participants were randomly assigned to one of two conditions. In one condition participants played a violent video game, participants in the other condition played a non-violent video game. After playing the video game all participants were asked to participate in a reaction time task in which they competed (ostensibly) against an opponent seated in another room. Whenever participants won a round, they had the opportunity to punish the opponent. The punishment consisted of a very unpleasant noise; participants were asked to calibrate the sound's duration and its volume; these settings served as measures of participants' aggressive tendencies. Comparing the average duration and volume settings between the two conditions showed that those who had played the violent video game reacted [did not react] more aggressively than those who played the non-violent video game. The authors of the study concluded that consuming violent video games leads [does not lead] to an increase in aggression. The authors stated that "violent video games provide a forum for learning and practicing aggressive reactions" ["playing violent video games does not constitute a risk factor for behaving aggressively"].

After reading the summary, participants were asked to what extent they felt that this research *stigmatizes* gamers, with two items ("I think that this study was designed to devalue video game players" and "I think that this study denounces video game players;" Cronbach's $\alpha = .89$). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*).

Next, participants were asked to *evaluate* the study and the competence of the authors on seven items (six adapted from Study 1 plus the item "I think that this study was a waste of public money;" Cronbach's $\alpha = .91$). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*) with higher values indicating a more negative evaluation of the study and the researchers responsible for these studies.

Anger about the study was measured with two items ("I was irritated about the study" and "I was outraged when I read the summary of the study;" Cronbach's $\alpha = .91$). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*).

Descriptive statistics and correlations between all dependent variables and identification at Time 1 are displayed in Table 3.

Results

Negative Evaluations

According to Hypothesis 1, we expected that identification with the group of gamers (measured at Time 1) moderates the effect of condition on evaluation such that strongly identified gamers react particularly negatively and critically toward a study that corroborates the violent-games-effect hypothesis, but not toward a study that refutes it. This was tested via moderated regression analysis (cf. Cohen, Cohen, West, & Aiken, 2003). Condition was effect coded (-1 = harmless, $+1$ = harmful), and identification was centered prior to computing product terms (cf. Aiken & West, 1991). As expected, negative evaluations were predicted by the Condition × Identification interaction, $B = 0.27$, $SE(B) = 0.11$, $p = .01$, $\Delta R^2 = .06$. Simple slopes analyses revealed that the effect of condition was significant for strongly identified gamers (i.e., 1 *SD* above the sample mean), $B = 0.38$, $SE(B) = 0.18$, $p = .03$, but not for weakly identified gamers (i.e., 1 *SD* below the sample mean), $B = -0.24$, $SE(B) = 0.17$, $p = .17$. No other effects were significant on a 5% level. Predicted means are displayed in Figure 2.

[3]When individuals who failed the attention tests were included in the analysis, the Condition × Identification interaction effect neither predicted perceived stigmatization ($p = .48$) nor anger about the study ($p = .79$). Furthermore, anger about the study did not mediate the conditional effect of condition (i.e., study type), neither among weakly (95% CI [−0.08, 0.19]) nor among strongly identified gamers (95% CI [−0.13, 0.16]). However, perceived stigmatization still mediated the conditional effect of condition (i.e., study type) among strongly identified gamers (95% CI [0.03, 0.27]), but not among weakly identified gamers (95% CI [−0.01, 0.19]).

Table 3. Descriptive statistics and correlations between variables in Study 2

Variable	*M* (*SD*)	Correlations (1)	(2)	(3)	(4)
Identification with the group of gamers at Time 1 (1)	2.81 (1.14)	1.00			
Negative evaluations (2)	3.29 (1.23)	0.11	1.00		
Anger about the study (3)	2.02 (1.40)	0.20*	0.64***	1.00	
Perceived stigmatization (4)	2.39 (1.51)	0.39***	0.49***	0.47***	1.00

Note: $N = 97$. $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

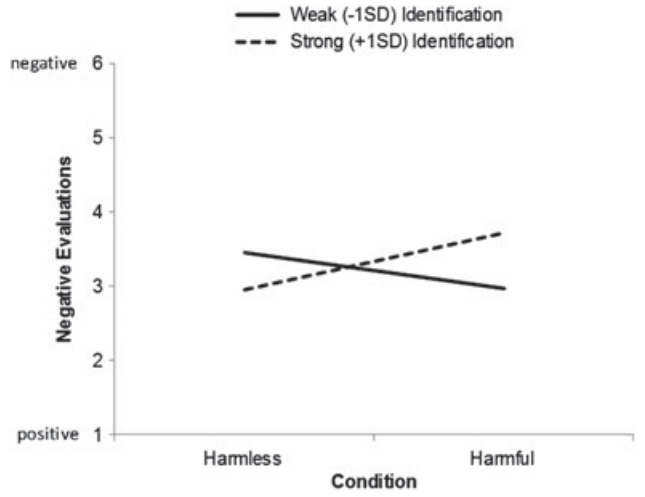

Figure 2. Negative evaluations by experimental condition and identification with the group of gamers (Study 2)

Perceived Stigmatization

According to Hypothesis 2, we expected that the Identification × Condition interaction effect is mediated by perceived stigmatization. This hypothesis was tested with a moderated mediation model (Figure 3). The Identification × Condition interaction effect on perceived stigmatization was only marginally significant, $B = 0.21$, $SE(B) = 0.12$, $p = .08$, $\Delta R^2 = .02$. However, simple slopes analyses confirmed that the effect of condition was significant for strongly identified gamers, $B = 0.75$, $SE(B) = 0.18$, $p < .001$, but not for weakly identified gamers, $B = 0.27$, $SE(B) = 0.18$, $p = .15$ (Table 4 and Figure 4). The conditional indirect effects of Condition × Identification on negative evaluations via perceived stigmatization were tested by inspecting bias-corrected 95% CIs obtained by bootstrapping using Hayes' (2013) PROCESS macro (5000 resamples). In line with our hypothesis, the indirect effect was significant for strongly identified gamers, $B = 0.33$, $SE(B) = 0.11$, 95% CI [0.15, 0.59], but not for weakly identified gamers, $B = 0.12$, $SE(B) = 0.07$, 95% CI [−0.001, 0.29].

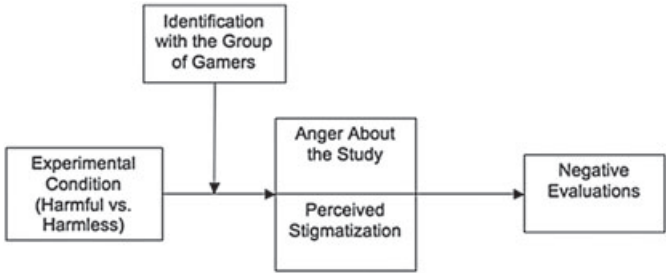

Figure 3. Moderated mediation model (Study 2)

Anger

Finally, we hypothesized that the interaction effect of Condition × Identification is mediated by anger about the study. This hypothesis was again tested with a moderated mediation model (Figure 3). In line with our reasoning, identification at Time 1 moderated the effect of condition on anger about the study, $B = 0.27$, $SE(B) = 0.12$, $p = .03$, $\Delta R^2 = .05$. Simple slopes analyses revealed that the effect of condition was significant for strongly identified gamers, $B = 0.47$, $SE(B) = 0.20$, $p = .02$, but not for weakly identified gamers, $B = -0.14$, $SE(B) = 0.20$ $p = .46$ (Table 4 and Figure 5). The conditional indirect effects of condition on negative evaluations via anger were tested by inspecting bias-corrected 95% CIs obtained by bootstrapping using Hayes' (2013) PROCESS macro (5000 resamples). In line with our hypothesis, the indirect effect was significant for strongly, $B = 0.26$, $SE(B) = 0.12$, 95% CI [0.04, 0.52], but not for weakly identified gamers, $B = -0.08$, $SE(B) = 0.10$, 95% CI [−0.29, 0.11].

Discussion

The results of Study 2 replicate and extend our findings from Study 1. They provide additional support for our notion that the evaluation of research findings is influenced by the degree to which gamers identify with their in-group and that this effect is mediated by group-based perceptions (stigmatization) and negative emotions (anger). When confronted with a research finding that corroborated the violent-games-effect hypothesis, strongly identified gamers reacted with more anger, a higher degree of perceived stigmatization, and more negative evaluations than did weakly identified gamers. Anger and perceived stigmatization mediated the effect of condition on negative evaluations only for strongly identified gamers; in other words, these participants were more likely to criticize a study reporting detrimental effects of violent games because they experienced anger about the study and perceived it as more stigmatizing. Notably, negative evaluations clearly extended beyond the particular study participants were confronted with: Some of the items referred to the researchers' competence and their (un)biasedness. This corroborates our notion that strongly identified gamers expressed a general bias toward entire research areas if they produce potentially identity-threatening findings.

Even though the results of Study 2 generally support our predictions, there are two limitations. Firstly, it is important to note that although anger about the study participants were confronted with was—technically speaking—a mediator variable in our model (Figure 3), it was measured *after* the

Table 4. Results of multiple regression analyses (Study 2)

Predictor variables	Model 1 (DV: negative evaluations)	Model 2 (DV: perceived stigmatization)	Model 3 (DV: negative evaluations)	Model 4 (DV: anger about the study)	Model 5 (DV: negative evaluations)
Constant term	3.27	2.37	2.22	2.00	2.18
Condition: study type (−1 harmless; +1 harmful)	0.07	0.51***	−0.16	0.16	−0.04
Identification with the group of gamers at Time 1	0.05	0.43***	−0.14	0.18	−0.02
Condition × Identification (Time 1)	0.27*	0.21†	0.18†	0.27*	0.13
Perceived stigmatization	—	—	0.44***	—	—
Anger about the study	—	—	—	—	0.55***
R^2	0.08	0.28	0.29	0.10	0.43

Note: $N = 97$. DV, dependent variable. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

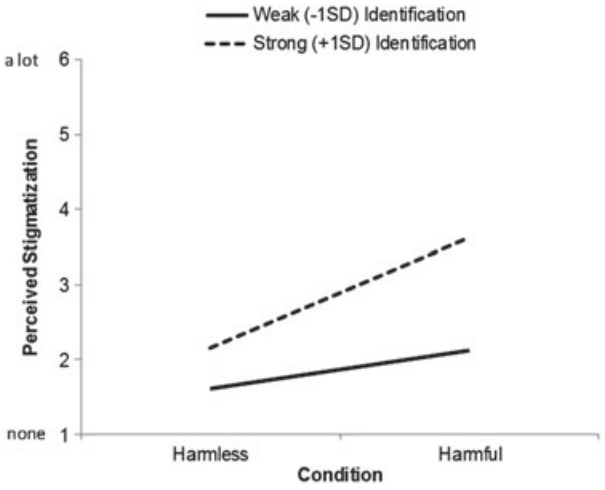

Figure 4. Perceived stigmatization by experimental condition and identification with the group of gamers (Study 2)

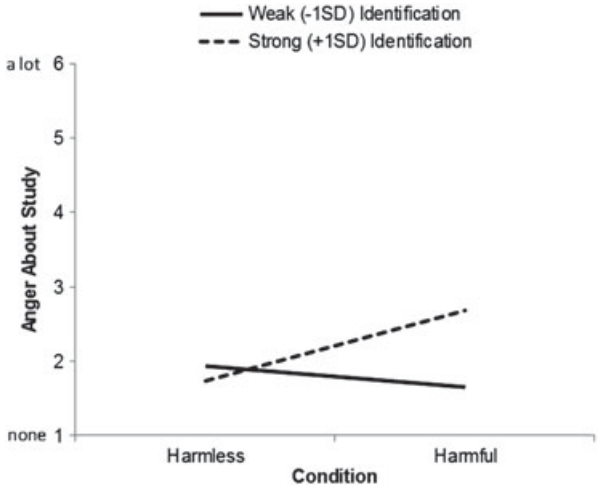

Figure 5. Anger about the study by experimental condition and identification with the group of gamers (Study 2)

evaluation of the study (that is, the dependent variable). This was performed in order to rule out the possibility that asking participants explicitly about their emotions might have created an artificial demand or might have unwanted priming effects, which, in turn, could have influenced evaluations artificially. Secondly, the attrition rate in the study was quite substantial. Although using attention tests in order to increase the statistical power of a test leads to comparable attrition rates even in laboratory settings (Oppenheimer et al., 2009), in our case, this might have been especially due to the payment politics of the hired sampling agency: Participants are not immediately paid for their participation. Instead, they receive virtual "credit points" in order to take part in raffles or are disbursed when they reach a certain amount. This might have motivated participants to skip reading the scientific summary in order to finish the study as quickly as possible. We tried to avoid this problem in Study 3 by recruiting participants in gaming forums in which the motivation to read about research on the effects of violent video games should be higher. Whereas Study 2 was designed to investigate potential mediators for the biased evaluation of scientific findings elicited by a social identity threat, Study 3 investigated whether the effect of identification is truly independent from an attitude inconsistency and/or behavioral preference inconsistency effect and generalizes to the entire field of violent video games research.

STUDY 3

Study 3 aimed at replicating the moderating effect of identification on negative and critical evaluations of social scientific research, and to once more rule out two previously mentioned alternative explanations, that is, beliefs about the effects of violent video games and gaming habits. We tested whether the effect of identification on negative evaluations persists even after controlling for effect beliefs and gaming habits. In contrast to Study 1, we used an experimental design to test this hypothesis. Additionally, we tested whether gamers' negative evaluations extend beyond the particular study and its authors and generalize to the entire field of violent video games research.

Method

Participants

The study was advertised in several German gaming Web forums and mailing lists. During the time this study was online, the forums were monitored for comments about the study, which would have influenced future participants' responses. No such comments were posted. In all, 533 people started the questionnaire; 228 of them (43%) finished it successfully.

Twenty-nine participants were excluded from further analyses because these people indicated that they had not played any video games during the last 12 months ($n = 4$), failed the attention test (discussed later; $n = 22$) or had more than 25% missing values on one or more scales ($n = 3$).[4] Therefore, the final sample consisted of 199 participants (7.5% women). Ages ranged between 16 and 45 years ($M = 23.13$; $SD = 5.96$). We included minors (16 years and older) in order to increase the generalizability of our results. More than two thirds of people in Germany between 14 and 17 years play video games, and especially young people are more likely to identify more strongly with the group of gamers (Quandt, Festl, & Scharkow, 2011). Full informed consent was obtained before participants started the study. Furthermore, the study involved neither deception nor did it have any negative consequences. Thus, all participants were treated in accordance with ethical guidelines.

Materials and Measures

The design of Study 3 was similar to Study 2 with the only exception that all measures were assessed at a single measurement occasion. First, participants were asked whether or not they had played any video games during the last 12 months. Those who answered "no" to this question were thanked and redirected to a different website.

Gaming habits. Those who indicated playing video games during the last year were first asked how many hours per week they usually spend playing each of eight different video game genres of which we computed a violence frequency index (Study 1).

Next, *effect beliefs* (Study 1, plus the item "aggressive behavioral tendencies;" Cronbach's $\alpha = .81$) and *identification* with the group of gamers (five-item scale used in Study 1, plus one item adapted from Mael and Tetrick, 1992, which seems particularly important in the context of the violent video games debate: "When somebody criticizes gamers, it feels like a personal insult"; Cronbach's $\alpha = .85$) were measured. Ratings were obtained on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*).

Participants were informed that the study they would have to evaluate was randomly chosen from a pool of different empirical studies. This was performed in order to prevent participants from assuming that the presented study was prototypical for the entire field of research. The texts they read were the same as in Study 2. Again, participants were randomly assigned to either a harmful condition, in which the results of the study corroborated the violent-games-effect hypothesis, or a harmless condition, in which the results of the study refuted this hypothesis. Importantly, gaming habits, beliefs about the effects of violent video games, and identification with the group of gamers did not reliably differ between these two conditions (all t's$(197) \leq 0.47$, p's $\geq .64$). Next, participants evaluated the study using the same seven-item scale as in Study 2. Additionally, four items explicitly referring to the entire research area on the effects of violent video games (Study 1) were added to the scale (Cronbach's $\alpha = .85$).

[4]When individuals who failed the attention tests were included in the analysis, the pattern of results remained the same.

Finally, demographic information was assessed. Completing the survey took about 16 minutes. Among all participants who completed the survey, 10 online shopping vouchers (worth €20 each) were raffled. Descriptive statistics and correlations between all variables are displayed in Table 5.

Results

Our central hypothesis (i.e., strongly identified gamers express more fundamentally negative evaluations in the harmful condition) was tested via moderated regression analysis. Again, condition was effect coded (−1 = harmless, +1 = harmful), and identification was centered prior to computing product terms. As expected, negative evaluations were predicted by the Condition × Identification interaction, $B = 0.15$, $SE(B) = 0.05$, $p = .001$, $\Delta R^2 = .04$. Simple slopes analyses revealed that the effect of condition was larger for strongly identified gamers (i.e., 1 *SD* above the sample mean), $B = 0.66$, $SE(B) = 0.08$, p .001, than for weakly identified gamers (i.e., 1 *SD* below the sample mean), $B = 0.29$, $SE(B) = 0.08$, $p < .001$, although the latter was significant as well. Additionally, we found a main effect of experimental condition, $B = 0.48$, $SE(B) = 0.06$, $p < .001$: Participants expressed more positive attitudes toward media violence research in the "harmless" condition than in the "harmful" condition. Predicted means are displayed in Figure 6.

Next, we tested whether the moderator effect of identification even held after controlling for gaming habits and effect beliefs. When controlling for these variables (including main effects and the respective condition interaction terms), the Condition × Identification interaction effect was still significant and in the expected direction, $B = 0.13$, $SE(B) = 0.05$, $p = .01$, $\Delta R^2 = .02$, whereas neither the Condition × Beliefs interaction nor Condition × Gaming Habits interaction effect significantly predicted negative evaluations (p's $\geq .22$). Again, the effect of condition was larger for strongly identified gamers (i.e., 1 *SD* above the sample mean), $B = 0.64$, $SE(B) = 0.08$, $p < .001$, than for weakly identified gamers (i.e., 1 *SD* below the sample mean), $B = 0.32$, $SE(B) = 0.09$, $p < .001$, although the latter was significant as well. This demonstrates that social identification predicts a biased evaluation of research on violent games effects over and above effect beliefs and gaming habits.

Discussion

Results from Study 3 provide additional evidence that a biased evaluation of scientific research findings can be explained by

Table 5. Descriptive statistics and correlations between variables in Study 3

		Correlations			
Variable	*M* (*SD*)	(1)	(2)	(3)	(4)
Gaming habits (1)	36.41 (30.53)				
Effect beliefs (2)	−0.10 (0.79)	−0.21**			
Identification with the group of gamers (3)	3.70 (1.23)	0.45***	−0.10		
Negative evaluations (4)	3.81 (0.94)	0.12†	−0.06	0.09	

Note: $N = 199$. †$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$.

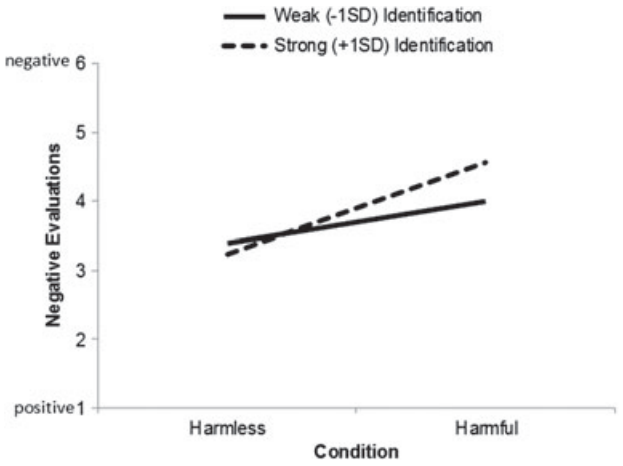

Figure 6. Negative evaluations by experimental condition and identification with the group of gamers (Study 3)

gamers' identification with their in-group and that the effect of identification on such evaluations is independent from effect beliefs and gaming habits. Notably, strongly identified gamers expressed harsh criticism toward the entire field of media violence research and the respective researchers although they were told that the study they read was randomly chosen from a pool of different studies with potentially different results. We can therefore assume that after being confronted with such research, strongly identified gamers adopt a fundamentally critical style of receiving and engaging with the respective scientific area. We speculate that this is because this kind of research symbolizes a threat to the social identity of gamers.

However, two findings are worth discussing. Firstly, in contrast to Study 2, we found a science-discrediting effect also for weakly identified gamers. This might be due to the different population our samples were recruited from. In Study 2, "weakly" identified gamers had an average identification score of 1.58, whereas "weakly" identified gamers in Study 3 had a mean score of 2.47. Even though we did not use the same social identification items in both studies, the difference demonstrates that participants in Study 2 were less strongly identified with the group of gamers than participants in Study 3. This difference in participants' average levels of identification might explain why we found a biasing effect also for "weakly" identified gamers in Study 3.

Secondly, and in contrast to Study 1, identification with the group of gamers did not correlate significantly with personal beliefs regarding negative effects of playing violent video games ($r = -.10$, $p = .16$). This finding is surprising at first glance, but it might be due to the more diverse and more strongly identified sample compared with that of Study 1. Some strongly identified gamers might think that violent video games can principally have aggression-enhancing effects on *some* people, but not on themselves ("third-person effect", Davison, 1983, also see Goldstein, 2005, for a similar argument).

GENERAL DISCUSSION

Research on the general public's understanding of and engagement with science has grown during recent years. This research has mainly focused on people's attitudes toward science as a function of their prior beliefs, prior attitudes, and prior knowledge about the respective scientific area (Ho et al., 2008) and on the cultural dependence of science evaluation (Kahan et al., 2011). Much less research has been devoted to the question of whether *social* identity processes also play a role for the formation of attitudes toward scientific research findings and programs. The present research aimed to fill this gap. We focused on the violent video games debate and showed that people who play video games on a regular basis are more likely to discredit scientific evidence demonstrating detrimental effects of violent video games and to express particularly harsh and critical attitudes toward video games effect research (and the respective researchers) when they identify strongly with the social category of gamers. This effect is at least partly mediated by perceived stigmatization and anger (Studies 1 and 2), and it cannot be explained by gaming habits or prior beliefs about the effects of playing violent video games (Studies 1 and 3).

These findings provide evidence for our assumption that research on the effects of violent video games symbolizes a threat to the social identity of gamers. We can therefore speculate that the harsh and extremely critical evaluations of this research expressed by gamers in Internet forums, social networks, or online discussions (see the quotes at the beginning of this article) represent some sort of "collective action" against science (cf. Leach et al., 2006, 2007; van Zomeren et al., 2008). We believe that this is a general principle that applies not only to research on the effects of violent video games, but to other research areas as well: Whenever scientific evidence has the potential to threaten a group's identity, we believe that the way in which group members react to such evidence can be explained by social identity and collective action processes. On a practical level, our research provides new insights into how scientific evidence is evaluated and how it can be instrumentalized in public debates. This might be especially interesting for debates in which certain groups are in the public focus, such as, for instance, gender groups, and also religious groups or vegetarians. For example, we would hypothesize that strongly identified vegetarians who are confronted with research showing that a vegetarian diet has negative consequences for the environment (e.g., through increased greenhouse gas emissions) would also react more negatively toward such research because they feel that their group's value is threatened.

Limitations and Directions for Future Research

The conclusions we drew from our data are partly based upon correlational evidence. Thus, we cannot fully rule out that a critical attitude toward video games effect research has already had a prior causal effect on people's social identification. Maybe those participants who agreed being identified with gamers are those who had critically evaluated social scientific research in the past. One way to test the assumed causal effect of identification on critical attitudes toward media violence research more directly would be to experimentally manipulate gamers' level of identification with their in-group (e.g., Jetten et al., 1997; Leonardelli & Brewer, 2001). Future research

should use such experimental paradigms in order to establish the hypothesized causal link of identification more strictly.

Our findings provide first evidence for the influence of social identity processes, in our case, social identification with a group that has been targeted by social scientific research, on individual attitudes toward science. We will now discuss two possible psychological mechanisms for this effect, and we hope that this discussion will stimulate further research on this topic. These two mechanisms are as follows: (1) normative influences by one's in-group and (2) epistemic biases operating on the level of text comprehension.

Science Criticism as Group Norm

People are more likely to adhere to group norms when the group's positive value has been threatened. For example, when group norms are salient, people who strongly identify with their group act more in accordance with salient norms (Jetten et al., 1997). In our case, strongly identified gamers may believe that a "gamer norm" would prescribe to discredit all kinds of potentially threatening research ("science-hostile group norm"), and their fundamentally critical style of evaluating the "harmful" study might reflect a kind of group norm-consistent behavior. Recently, Sjöström, Sowka, Gollwitzer, Klimmt, and Rothmund (2013) theorized about a "hostile science effect" as a counterpart to the "hostile media effect." A science-hostile group norm would lend itself to explain such a "hostile science effect." The assumption that devaluing scientific research reflects a group norm could be tested either by measuring inferred group norms among strongly identified gamers or by manipulating group norms experimentally.

Cognitive Mechanisms of Group-based Science Discrediting

A somewhat related question that future research should address is to what extent the discrediting effect that we found in our studies is based on an intentional, deliberative cognitive process (such as following a group norm) or rather an automatic process that operates on a perceptual level. Regarding the latter perspective, one could assume that strongly identified gamers read a threatening scientific study in a different fashion than weakly identified gamers do. One way to investigate whether the effect of social identification on evaluative biases already operates on a perceptual level would be to adopt existing paradigms from text comprehension research (e.g., Richter, Schroeder, & Wöhrmann, 2009). Richter and colleagues found that participants with strong prior background knowledge rejected false assertion as efficiently as they verified true assertions even when the assertions were learned under additional cognitive load. According to Richter et al. (2009), this demonstrates an automatic validation process that protects mental representations from being contaminated by false and inaccurate information. If our effects are based on an automatic process, strongly identified gamers should reject threatening information (e.g., "Violent video games can lead to increased aggressiveness") as quickly and automatically as objectively "false" information (e.g., "Violent video games can lead to increased body height"), even under cognitive load.

Consequences for a Public Engagement with Science

Our research suggests that social identification with a targeted group affects people's attitudes toward research findings and research programs. We also suggested that expressing these attitudes can be conceptualized as a form of "collective action." If this assumption is correct, one might wonder about the downstream consequences of such fundamentally critical attitudes toward social scientific research. For example, gamers who evaluate media effects research more negatively might also be more likely to publicly express their opinion about such research and about these researchers; they might even demonstrate against the stigmatization they feel to be exposed to. In June 2009, hundreds of gamers in three German cities protested against being stigmatized by the public debate on video game violence. Their slogan was "We are gamers: Demo for video game culture." [5]

Another form of collective action would be to make use of the opportunities provided by Web 2.0 (Brunsting & Postmes, 2002; Postmes, 2007). Web 2.0 allows an extremely rapid distribution of information (and misinformation) and, furthermore, gives many people unlimited access to immense quantities of information (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). Thus, it creates a perfect space (especially for computer-affine people) to discuss group-relevant scientific findings. In our case, gamers might advocate their own opinion to a broader public because they fear that a study confirming a violent games effect might lead to a stigmatization of gamers. Besides a motivation to counteract an anticipated stigmatizing effect of a scientific study on the public, blogging, twittering, or posting in social networks about potentially threatening research might also serve a self-affirmative goal (Toma & Hancock, 2013). In social networks, for example, other gamers should be especially interested in negative posts about undesirable research findings because such posts might have an affirming effect on their social identity. Furthermore, strongly identified gamers should also be more likely to react toward these negative comments with even harsher science-discrediting comments themselves, affirming the positive identity of themselves and other gamers. This might result in a positive feedback loop, which is often observed in social networks or Web forums. It would therefore be interesting to test these predictions in a simulated online environment in which people have the possibility to post comments and to react directly toward comments made by other participants.

Conclusion

The present research sheds light on why gamers may react so critically toward the research on the effects of violent video games. These findings emphasize the role of group identification, perceived stigmatization, and emotions in people's engagement with science. Theoretically, our research shows that the social identity approach can be useful to describe and explain harsh negative evaluations of scientific findings and entire research programs, as illustrated in the quotes at the beginning of this article. On a more applied level, our results

[5]See http://www.wirsindgamer.de (retrieved 8 November 2013).

emphasize the role of identity concerns in polarized public debates in which agents use arguments backed up by scientific studies, and it corroborates the importance of social identity processes for motivated reasoning and science communication.

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APPENDIX

ENGLISH TRANSLATION OF THE DESCRIPTION OF RESEARCH ON THE EFFECTS OF VIOLENT VIDEO GAMES IN STUDY 1

The following part asks for your evaluation of a field of research, namely the research on the effects of violent video games.

Research on the effects of violent video games aims to investigate short-term as well as long-term impacts using either experiments or surveys.

Experiments might look like this: First, people are randomly assigned (e.g., by the flip of a coin) to play a video game with either violent or non-violent contents for about 20 minutes. Afterwards, participants' tendency to behave aggressively is measured. If those who played a violent video game are, on average, more aggressive than those who played the non-violent game, the result indicates an aggression-enhancing effect of the game.

Surveys might look like this: People are asked about their regular consumption of violent video games and about their aggressiveness twice with, for example, an interval of one year in-between the two surveys. Statistical procedures are used to assess whether consuming violent video games influences aggressiveness over time.

4 Manuscript #2

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RESEARCH ARTICLE

Social Identity Threat Motivates Science-Discrediting Online Comments

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Abstract

Experiencing social identity threat from scientific findings can lead people to cognitively devalue the respective findings. Three studies examined whether potentially threatening scientific findings motivate group members to take action against the respective findings by publicly discrediting them on the Web. Results show that strongly (vs. weakly) identified group members (i.e., people who identified as "gamers") were particularly likely to discredit social identity threatening findings publicly (i.e., studies that found an effect of playing violent video games on aggression). A content analytical evaluation of online comments revealed that social identification specifically predicted critiques of the methodology employed in potentially threatening, but not in non-threatening research (Study 2). Furthermore, when participants were collectively (vs. self-) affirmed, identification did no longer predict discrediting posting behavior (Study 3). These findings contribute to the understanding of the formation of online collective action and add to the burgeoning literature on the question why certain scientific findings sometimes face a broad public opposition.

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Introduction

"Another simple pseudo-scientist who gets a pat on the back for finding what he was looking for. No subtle thinking here. No qualifying or consideration of alternate interpretation. No honest presentation of the limits of your study. No alternative explanations. This is why the majority of social scientists are flimsy. It is a weak science desperately pretend it has hard evidence for complex phenomena."

The Internet has changed the way we communicate and engage with each other, and it has also changed the way scientists communicate their findings to the general public as well as how laypersons inform themselves and engage with science. Before the Internet era, science communication was mostly indirect: newspapers, magazines, and TV shows reported about science, and the public had little chance to actively engage with scientists and their research. This has changed. Science blogs, discussion forums, podcasts, and video channels give scientists the opportunity to inform and discuss their research directly with people all over the world. These new possibilities were enthusiastically greeted by scientists across diverse disciplines [1] and many of them actively use the new communicational features provided by the Internet to inspire the public or even to acquire public funding.

Competing Interests: The authors have declared that no competing interests exist.

As always, new communicative possibilities not only promise opportunities, they also involve problems. Just as it was never easier to publicly promote science, it was also never easier to publicly discredit it. Blogs, discussion forums, or newspaper websites allow people to directly evaluate and devaluate scientific findings they read about online. Plausibly, the distribution of praise and criticism in publicly visible online comments to a particular scientific enterprise has consequences for the general public's impressions about the quality of the respective research [2] and also about the risks associated with the scientific enterprise [3]. Traditionally, critiques about research were voiced in commentary sections of journals in which a finding was published. These commentaries were also peer-reviewed, which was an attempt to secure a certain degree of qualification. This is not the case with online comments. For instance, a YouTube video produced by a prominent researcher on the effects of violent video games [4] yielded 185 ratings (as of March 31, 2014). The vast majority of these ratings (86%) were negative (i.e., the video was "disliked"), and 85 out of 97 users severely criticized the author's research fundamentally, attacked his scientific reputation, and offended him personally by posting a negative comment. The statement quoted at the beginning of this article is one of these comments. This example illustrates that the Internet, especially "Web 2.0" features, open the stage for a public devaluation of science by anybody who is motivated to do so. The consequences of this particular form of "public engagement with science" can be profoundly negative [3].

One might argue that we are overly pessimistic, and that cases in which scientific findings face a notable public opposition are rare. Unfortunately, this is not the case. Misinformation concerning scientific findings is widespread, and the Internet enables an effective dissemination of these false beliefs [5]. Anthropogenic climate change, evolutionary theory, side-effects of vaccines, effectiveness of alternative medicine, or the effects of violent video games: all these issues were controversially and heatedly discussed in the public. The question what motivates people to publicly discredit scientific findings and to disseminate mistrust in science on the Web is therefore of great societal interest and importance.

So far, science communication research has identified several factors that may promote a critical evaluation of research results. For instance, findings that call long-held values, beliefs, or attitudes into question are evaluated more negatively than results confirming these beliefs [6–9]. Notably, most of the research on science communication has focused on how *individually* held attitudes or beliefs influence people's reception of science. However, scientific research sometimes affects social or societal groups–either explicitly or implicitly. For example, research on the consequences of a vegetarian diet affects the group of vegetarians; research on men's sexist attitudes against women affects the group of men; and research on the effects of playing violent video games affects the group of video game players (who are henceforth referred to as "gamers" for reasons of simplicity). Recent evidence suggests that whenever research affects entire groups, social identity concerns play an important role in the reception of scientific findings [10–12]. For instance, Nauroth and colleagues [11] showed that gamers' evaluation of research about the negative effects of playing violent video games was best explained by their identification with the group of gamers over and above their personal beliefs about the effects of violent video games and their gaming habits. These results indicate that social factors, such as group membership and identification with one's group, are crucial in the reception of scientific findings as soon as these findings directly or indirectly affect the respective group.

Although much research has focused on factors that explain a biased *evaluation* of scientific findings, virtually no research has addressed the *behavioral outcomes* of these evaluations so far. This is remarkable since holding a negative attitude against research must not necessarily translate into action against the respective research [13]. It therefore remains an open question whether the effects found with regard to the evaluation of scientific findings have also downstream behavioral consequences. At the societal level, understanding such behavioral

consequences, that is, publicly discrediting or even actively opposing science, are highly relevant, since they can substantially impair positive societal change.

The present research aims to fill this gap: based upon social identity theory [14,15], the social identity model of deindividuation effects [16] and research on collective action [17], we argue that social identification and social identity threat can explain why people negatively evaluate *and* publicly oppose scientific findings. Whenever research findings negatively affect a certain group, we hypothesize that publicly criticizing such research on the Web is motivated by a perceived social identity threat and directed at defending the group's image and one's social identity.

Social Identification Motivates Collective Action (Against Science)

How group-relevant information is interpreted strongly depends on whether or not people categorize themselves as members of the respective group [18,19]. Thus, a scientific study should be evaluated more positively when it affirms one's social identity. In line with this notion, Morton and colleagues [10] showed that participants considered a study to be more "scientific" and were more interested in this research when it affirmed their gender identity. They concluded that scientific findings are more likely to be perceived as credible and plausible when they provide people with a positive sense of identity, irrespective of the actual scientific state of the art. In addition, the degree to which people identify with a group qualifies the effect of group membership on social information processing: strongly identified group members are more likely to show a biased evaluation than weakly identified members when the information is threatening to their respective social identity [20,21]. In line with this argument, Nauroth and colleagues [11] showed that strongly (vs. weakly) identified gamers were more likely to devalue research on the detrimental effects of violent video games to the extent that this research constituted a social identity threat.

Rejecting and devaluing science in private is one thing, but criticizing science and the scientists behind it in public is something different, and not much is known about the social and cognitive dynamics underlying this detrimental form of a "public engagement with science." Thus, a look into the literature on behavioral responses towards social identity threat might be helpful here. A first important finding from this literature is that, in the face of a social identity threat, strong identifiers show solidarity toward the in-group by taking action against the threat (e.g., protesting). For instance, Scheepers and colleagues [22] demonstrated that strong identifiers are more likely than weak identifiers to insult the out-group when the in-group was threatened. According to Scheepers and colleagues, the instrumentality of such out-group derogation is to direct in-group members' attention and effort toward group-relevant goals and to motivate collective action. In the same vein, Van Zomeren and colleagues [17] provided evidence for the importance of social identification for collective action in a comprehensive meta-analysis. These authors investigated perceived injustice, perceived efficacy, and social identification as potential psychological determinants of collective action tendencies. Results showed that social identification did not only promote collective action directly but also indirectly via perceived injustice and perceived efficacy. Thus, there is evidence that social identification predicts not only a biased evaluation of threatening information but also (collective) social action against a social identity threat. However, there is virtually no research on the predictive value of social identification in the area of science communication. Based on these arguments and findings, we hypothesize that strongly identified group members should be more inclined to actually show science-discrediting behavior against a threatening scientific study.

The empirical evidence on social identity and collective action reviewed so far only investigated non-online behavior. However, there is reason to assume that these effects also apply to behavior in the online realm. The SIDE model of computer-mediated communication effects proposes that visual anonymity (as on the Web) makes it difficult to discern individuals' interpersonal differences and, thereby, depersonalizes self- and other-perception [16]. When a social identity is salient, visual anonymity should amplify social identity influences on perceptions and behavior [23]. For example, Postmes and colleagues [24] showed that visual anonymity leads to a stronger identification with the in-group and a greater consensus with the in-group's norms. Thus, social identity effects, as predicted by social identity theory and research on collective action, should even be more pronounced on the Web when a social identity is already salient [25]. Applied to the case in which strongly identified group members read an article presenting potenially threatening research results on a news site, anonymity should even enhance their identification and, in turn, they should be more inclined to evaluate the research findings negatively and react upon the article with a harsh, offensive and science-discrediting comment.

Acting Against Science as a Means to Restore Social Identity

Even though it is theoretically plausible to assume that social identification motivates science-discrediting comments, the psychological mechanism underlying this effect is not clear. Basing our research on the social identity approach [14,15], we conceptualize social identity as aspect of the overall self-concept that is independent from personal identity. *Personal identity* refers to people's self-definition as unique and different from other individuals. *Social identity*, by contrast, refers to the part of the self-concept being defined by one's affiliation to social categories. In the context of an identity threat emanating from scientific research this distinction becomes important because it has immediate consequences on one's reactions to the threat and the motivations underlying these reactions. A research finding indicating the harmfulness of video game violence might not only pose a threat to one's social identity but also to one's personal identity. For example, strongly identified gamers could define themselves as being competent users of digital media. Thus, group members, particularly strong identifiers, may feel personally attacked by this research experiencing an ego-threat [26]. Posting a science-discrediting comment could then be understood as an ego-defense mechanism. In other words, even though posting negative comments is predicted by social identification, it may not so much be a collective, but rather a personal issue.

Research on self-affirmation theory [27] has shown that defensive reactions toward threatening information are less likely when individuals are given the opportunity to affirm their personal identity [28]. For example, Toma and Hancock [29] demonstrated that participants were more receptive toward negative performance feedback when they wrote a short essay about a value that is important to them ("self-affirmation"). Notably, this was also the case when participants were allowed to spend time on their Facebook profile, demonstrating that personal identity concerns play an important role in explaining online behavior. Thus, if the mechanism underlying negative posting was motivated by personal identity concerns, self-affirming group members should lead them to refrain from posting a science-discrediting comment.

By contrast, posting negative comments might rather be genuinely motivated by the desire to affirm one's *social* identity. Since the self-concept of strong identifiers is more strongly based on their group membership [15,20] they should also have a higher motivation to restore their social identity [30]. Thus, acting against a social identity threat may rather aim to affirm one's social identity [31,32]. This reasoning is in line with research showing that strongly identified group members tend to choose social identity affirmative strategies after being threatened [33].

Since collective action is a social identity affirmative strategy [15] posting a science-discrediting comment on the Internet might also serve as a means to restore one's social identity after it has been threatened by the respective scientific finding.

If posting a negative comment was indeed motivated by the desire to reaffirm one's social identity, alternative ways of affirming one's social identity—for instance, shifting one's attention on the positive aspects of one's group—should therefore reduce the likelihood of posting a negative comment about potentially threatening research. This argument resonates with recent findings showing that alluding group members to positive group characteristics increases their acceptance of potentially threatening information. For instance, Sherman and colleagues [32] demonstrated that strongly identified university sports team fans were particularly likely to exhibit group serving attributions after their team lost. However, this bias was alleviated when strongly identified fans were asked to think and write about important values of their university. In other words, giving group members the opportunity to reflect upon positive aspects of their group ("collective affirmation") may act as a shield against potentially threatening information. This implies that collectively affirming group members should alleviate their desire to act against science as a means to restore their social identity, for instance, by posting science-discrediting online comments. If our reasoning was true and posting negative comments was a collective rather than a personal issue, a personal self-affirmation should be less effective than a group-based "collective" affirmation. Thus, we hypothesize that collectively affirmed strong identifiers should be less likely to post a harsh devaluing comment about a potentially threatening scientific finding than non-affirmed strong identifiers. Personal self-affirmation, however, should not have such an effect.

The Present Research

In the present research we focus on the violent video games debate in order to test our predictions. Potential negative effects of playing violent video games have been fiercely discussed over the last 15 years, not only outside the academic world, but inside as well [34,35]. The question of whether or not violent video games have detrimental effects is still vivid not only in the public media, but also in juridical processes [36]. Not surprisingly, the public opinion on whether violent video games have detrimental effects is divided [37]. Notably, this topic is particularly suited to investigate group influences on the evaluation of scientific findings since video game players–"gamers"–are primarily affected by the research conducted on violent video games, and most people are familiar with the topic [38].

The present article describes three studies designed to test two hypotheses: The *first* hypothesis is that strongly identified gamers are more likely to act against potentially threatening research results by writing (negative) online comments targeting the credibility of the research (Studies 1, 2, and 3). The *second* hypothesis is that this effect can be alleviated when gamers are collectively (but not personally) affirmed after being threatened (Study 3). Thus, Study 3 aims at elucidating the psychological mechanism underlying the effects found in Studies 1 and 2.

Studies 2 and 3 were conducted as part of a larger research project for which a global ethics approval was obtained from the psychology department's ethics committee at Philipps University Marburg (AZ: 2011-02K). Study 1 was conducted as part of a research project for which no ethics approval was required, neither from the funding agency nor from the department. However, all three studies were conducted in full accordance with (1) the declaration of Helsinki and (2) the ethics guidelines of the German Psychological Society. This includes–among others–obtaining informed consent, the right to withdraw at any time, and data protection. At the beginning of each study, prospective participants read detailed information regarding ethical guidelines (i.e., that the data are analyzed anonymously, that they are free to refrain from

participation in the study and to withdraw consent to participate at any time without disadvantage) and had to give informed consent to this information before being able to participate in the studies. All collected information that could have made identification of participants possible were deleted before analysis (i.e., e-mail addresses collected for the raffles).

Study 1

Study 1 provides a first test of the hypothesis that the extent to which people identify with the group of gamers positively predicts (self-reported) posting behavior when the research corroborates the violent-games-effect hypothesis (i.e., demonstrates that violent video games have detrimental effects).

Method

We reanalyzed data collected by Sjöström and colleagues [38], who investigated audience judgments of social sciences in the violent video games debate. They conducted an Internet-based questionnaire and recruited participants based upon a representative distribution of sex, age, level of education, and state of residence in Germany. A correlational design was used to examine the relationship between social identification and (self-reported) posting behavior under social identity threat and the absence of social identity threat.

Participants. Sjöström and colleagues sample consisted of 290 respondents with different levels of experience in playing video games. However, for the present article we were only interested in gamers, that is, people who play video games on a regular basis. Thus, 206 participants (i.e., 71%) were excluded from further analyses because they indicated that they do not regularly play video games (i.e., at least two hours per week; $n = 194$) or indicated that they were not able to assess the state of research (a crucial variable for the present research, see below; $n = 12$). Therefore, the final sample consisted of 84 participants (46% women). Ages ranged between 18 and 62 years ($M = 37.06$; $SD = 11.85$).

Materials and Measures. First, *identification*with the group of gamers was measured with an adapted version of Leach and colleagues [39] social identification scale, addressing the self-investment factor of social identification (10 items, e.g., "I am glad to be a gamer;" Cronbach's $\alpha = .92$). We replaced the item "The fact that I am a gamer is an important part of my identity" with "When somebody criticizes gamers, it feels like a personal insult". We included this item because it best measures a person's experience of the group as an important part of the self (see [39], p. 817). Notably, Leach and colleagues [39] (p. 151 and 165) also considered including a similar item ("I feel (personally) implicated when [In-group] people are criticized." see [41]) in their scale, but excluded it as being too vaguely formulated (which is true due to the term "implicated"). However, the wording of the item from Mael and Tetrick [40] is specific and it clearly measures self-group merging as an important facet of social identification (for a similar argument concerning this item see also [41], p. 91). That this is the case is also confirmed by the results of our scale analysis showing an adequate item discrimination of $r_{it} = .46$ (when omitting this item, the identification × current state of research interaction still predicted posting behavior, $B = 0.19$, $SE(B) = 0.09$, $p = .04$, $\Delta R^2 = .05$). Ratings were obtained on a six-point scale (1 = *strongly disagree*, 6 = *strongly agree*).

Next, the *assessment of the current state of violent video games research* was measured with one item ("According to your opinion, to what extent does the following statement apply to the current state of research: On average, violent video games increase aggressive thoughts, feelings, and behavior in the long term."). Responses were made on a five-point scale (-2 = "*the current state of research clearly contradicts this statement*," 2 = "*. . .clearly supports this statement*") with the additional option to indicate that one is not able to assess the state of research.

Table 1. Descriptive Statistics and Correlations between Variables in Study 1.

Variable	M (SD)	Correlations		
		(1)	(2)	(3)
Identification with the group of gamers (1)	2.63 (1.06)	1.00		
Assessment of the current state of research (2)	0.40 (1.20)	–0.32**	1.00	
Posting behavior (3)	1.92 (1.17)	0.21	–0.02	1.00

Notes. $N = 84$.
*$p < .05$
**$p < .01$
***$p < .001$.

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Therefore, positive values indicate participants' assumption that the current state of research shows that violent video games cause aggression, and negative values indicate that this is not the case.

Next, *posting behavior* was assessed with two items ("I comment on articles about violent video games on web portals (e.g., Spiegel Online)," and "I engage in discussions about violent video games in forums and blogs;" Cronbach's $\alpha = .90$). Responses were made on a six-point scale (1 = *never*, 6 = *very often*). Descriptive statistics and correlations between all variables are displayed in Table 1. Identification with the group of gamers and assessment of the current state of research were negatively correlated ($r = -.32$), which (plausibly) implies that strongly identified gamers were less likely to believe that the current research corroborates the violent-games-effect hypothesis compared to weakly identified gamers. Notably, however, this correlation was of medium size, which makes it possible to scrutinize the identification × current state of research interaction effect on posting behavior.

Results

We tested our hypothesis via moderated regression analysis [42] and centered identification and assessment of the current state of research prior to computing product terms [43]. As expected, self-reported posting behavior was predicted by the identification × current state of research interaction, $B = 0.21$, $SE(B) = 0.09$, $p = .03$, $\Delta R^2 = .06$. Simple slopes analyses revealed that the effect of current state of research was larger for strongly identified gamers (i.e., 1 *SD* above the sample mean), $B = 0.24$, $SE(B) = 0.14$, $p = .08$, than for weakly identified gamers (i.e., 1 *SD* below the sample mean), $B = -0.21$, $SE(B) = 0.16$, $p = .19$. Additionally, we found a main effect of identification, $B = 0.26$, $SE(B) = 0.12$, $p = .04$, indicating that strongly identified gamers were on average more likely to comment on research on violent video games. The main effect of assessment was not significant, $B = 0.02$, $SE(B) = 0.11$, $p = .88$. Predicted means are displayed in Fig. 1.

Discussion

The results of Study 1 provide first evidence for our notion that posting behavior is influenced by the degree to which gamers identify with their in-group. This finding supports our first hypothesis that potentially threatening research triggers behavioral responses in the form of online comments among strongly identified group members.

Although the results of Study 1 generally support our predictions, there are some limitations and shortcomings. Firstly, the items measuring posting behavior were rather unspecific. With

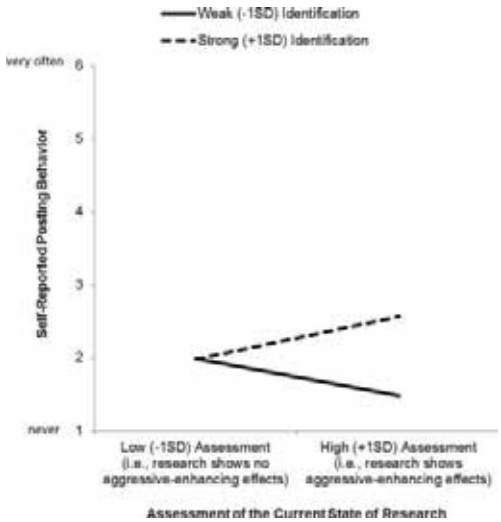

Figure 1. Self-reported posting behavior by identification with the group of gamers and assessment of the current state of research (Study 1).

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these items we have no information about the valence of the posted comments, only about the frequency. We know that strongly identified group members are more likely to comment on research about violent video games if they perceive research to confirm negative effects. However, we do not know whether strongly identified group members are more likely to post *discrediting* comments about threatening research. Secondly, we did not assess behavior directly, but merely relied on self-reports. Frequency self-reports are often biased and not an accurate assessment of the true behavior frequency [44]. Assessing posting behavior directly would certainly provide a better test of our first hypothesis. Finally, and most importantly, we used a correlational design to test our predictions. Possibly, the assessment of the current state of research is confounded by other variables not included in our study, such as a critical attitude towards science in general. In order to remedy these shortcomings, participants in Study 2 were asked to write a negative or positive blog comment about a threatening or non-threatening scientific study. Furthermore, Study 2 used an experimental approach in order to strengthen the internal validity of the design.

Study 2

Study 2 aimed at replicating the effect of identification on posting behavior. However, in contrast to Study 1, we used an experimental approach and a behavioral measure of posting behavior, which is able to discern between negative and positive comments. Participants could actually write a "pro" or "contra" comment about two scientific studies, one corroborating ("confirmatory" study) and one disconfirming ("confutative" study) the violent-games-effect hypothesis. Importantly, besides investigating the likelihood of writing a positive (i.e., "pro") or a negative (i.e., "contra") comment, we also content-analyzed all posted comments with regard to their evaluative and opinionative statements. We expected that strongly (vs. weakly) identified gamers were more likely to write a negative comment about the confirmatory study, but not about the confutative study.

Additionally, we implemented a blog environment in order to increase the ecological validity with the possibility to use a "like" or "dislike" button often found on the Internet. "Like" and "dislike" buttons provide an efficient way to indicate one's approval or disapproval of content

Table 2. Design of Study 2.

Condition	Confirmatory Study		Confutative Study	
Liking/ Disliking	"thumb up"-button (i.e., like)	"thumb down"-button (i.e., dislike)	"thumb up"-button (i.e., like)	"thumb down"-button (i.e., dislike)
Posting Behavior	"Pro comment" textbox (i.e., positive comment)	"Contra comment" textbox (i.e., negative comment)	"Pro comment" textbox (i.e., positive comment)	"Contra comment" textbox (i.e., negative comment)
Content Analysis	Frequency of 5 categories		Frequency of 5 categories	
Evaluation	Evaluation of the study (9 items)		Evaluation of the study (9 items)	

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on websites [45]. Therefore, these buttons constitute another opportunity for motivated group members to influence the public opinion about the featured research. Furthermore, we assessed participants' evaluation of the respective studies [11]. We expected that strongly (vs. weakly) identified gamers dislike the confirmatory study more often and evaluate the confirmatory study more negatively than the confutative study.

Method

Participants. Participants were recruited via an internal university student mailing list. In all, 976 people started the questionnaire; 705 of them (72%) finished it successfully. Fifty participants were excluded from further analyses because these people indicated that they had not played any video games during the last 12 months (n = 33) or had more than 25% missing values on one or more scales (n = 17). Therefore, the final sample consisted of 655 participants (34% women). Ages ranged between 18 and 51 years (M = 23.64; SD = 3.30). One tablet computer was raffled among all participants who completed the survey.

Design and Procedure. Study 2 was conducted as an online-based experimental survey using a one-factorial within-subjects design. Participants were told that a new blog about recent research findings was going to be launched soon, and that the first topic to be discussed in this new blog would be "violent video games." The survey would be conducted in order to identify studies suitable to be posted in the blog. Participants were instructed to read short summaries from two studies which were ostensibly randomly chosen from a larger pool of studies, to rate each study by "liking" or "disliking" it, and to comment on each study in the blog if they wished to do so (for a design overview see Table 2).

One of the two studies found empirical evidence for the hypothesis that playing violent video games has detrimental effects ("confirmatory study" condition) whereas the other refuted this hypothesis empirically ("confutative study" condition). In order to reduce suspicion and to enhance credibility, the two "studies" differed in their methodologies: One of them was said to have used a behavioral measure of aggression as the central dependent variable; the other used fMRI data (see S1 Appendix). The order in which the two studies (more precisely, the two experimental conditions) were presented as well as their respective methodologies was fully counterbalanced across participants. All patterns of results remained the same when the order and type of the manipulation studies and their interactions with identification where included in the analyses of posting behavior, liking/disliking behavior, and biased evaluation. Importantly, all interaction terms including identification (i.e., identification × order, identification × type, identification × order × type) were not significant on the 5% level.

Identification. First, identification with the group of gamers was measured with an adapted 5-item version of the Leach and colleagues [39] subscale of the self-investment factor. Additionally, we included one item to measure identification with the group of gamers on a

Table 3. Dependent Variable Coding Scheme for Liking/Disliking Behavior (Study 2).

		Confirmatory Study			
		like	no response	dislike	total
Confutative Study	like	0	1	1	
		(91)	(25)	(181)	(297)
	no response	–1	0	1	
		(8)	(139)	(11)	(158)
	dislike	–1	–1	0	
		(91)	(7)	(92)	(190)
	total	(190)	(171)	(284)	(645)

Notes. N = 655. Number of participants in each category in parentheses.

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broader level adapted from Postmes, Haslam, and Jans [46] ("I identify with the group of 'gamers'"). This six-item measure constituted a reliable scale (Cronbach's α = .92). Ratings were obtained on a six-point scale (1 = *strongly disagree*, 6 = *strongly agree*).

Liking/Disliking Behavior. Then, participants read the two study summaries and indicated whether they *liked* or *disliked* the respective study by clicking on a thumbs-up or thumbs-down shaped button below the respective summary. We were not able to collect data on liking/disliking from 10 participants because they had JavaScript deactivated in their browser. Clicking on a button was not mandatory; thus, there were three possible responses to each study: like, dislike, and no response. Table 3 shows how response patterns were coded for subsequent analyses. According to this coding scheme, response patterns in which (a) the confirmatory study (but not the confutative study) was disliked or those in which (b) the confutative study (but not the confirmatory study) was liked were coded as +1, indicating a *disliking bias against the confirmatory study*; patterns in which (a) the confirmatory study (but not the confutative study) was liked or those in which (b) the confutative study (but not the confirmatory study) was disliked were coded as –1, indicating a *liking bias in favor of the confirmatory study*. All remaining patterns (i.e., both studies were liked, both studies were disliked, or neither study received a response) were coded as 0. This coding scheme corresponds to our conceptual hypotheses: it directly compares those participants who remained neutral towards either study (coded with 0) against those who favor the confutative over the confirmatory study (coded with +1) and against those who favor the confirmatory over the confutative study (coded with –1).

Comments. On the same site below the like/dislike buttons, participants found two text boxes labeled "PRO comments" and "CONTRA comments." Participants had the opportunity to write a "pro" (positive) and/or a "contra" (negative) comment toward each study in the respective text box. Table 4 shows how response patterns were coded: patterns in which participants commented more *negatively* on the confirmatory than on the confutative study (and more positively on the confutative than on the confirmatory study) were coded as +1, indicating a *posting bias against the confirmatory study*; patterns in which participants commented more *positively* on the confirmatory than on the confutative study (and more *negatively* on the confutative than on the confirmatory study) were coded as –1, indicating a *posting bias in favor of the confirmatory study*; patterns in which none of the studies were commented on or in which both studies received similar comments were coded as 0 (no bias). Again, this coding scheme corresponds to our conceptual hypotheses: it directly compares those participants who did not favor either study in their comments (coded with 0) against those who criticize the confirmatory study more than the confutative study (coded with +1) and against those who praise

Table 4. Dependent Variable Coding Scheme for Posting Behavior (Study 2).

		Confirmatory Study				
		only positive	no comment	positive & negative	only negative	Total
Confutative Study	only positive	0	1	1	1	
		(53)	(5)	(6)	(154)	(218)
	no comment	–1	0	0	1	
		(11)	(123)	(1)	(22)	(157)
	positive & negative	–1	0	0	1	
		(5)	(4)	(28)	(20)	(57)
	only negative	–1	–1	–1	0	
		(89)	(11)	(18)	(105)	(223)
	total	(158)	(143)	(53)	(301)	(655)

Notes. N = 655. Number of participants in each category in parentheses.

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the confirmatory more than the confutative study (coded with –1). This coding scheme directly contrasts the two studies with regard to participants' commenting behavior. One anonymous reviewer pointed out that it would also be worthwhile to analyze participants' commenting behavior separately for each study. This analysis is reported in S1 and S2 Tables. Besides counting the number of "pro" and "contra" comments per article, these comments were also content-analyzed (see below).

Evaluation. After commenting on one summary, participants were asked to evaluate the respective research (including the authors) on nine items. Seven items were taken from Nauroth and colleagues [11] ("I think that this study was a waste of public money," "I think that these authors are not very competent," "I think that the results of this study are unambiguous" (recoded), "I think that these authors just find what they wanted to find," "I think that this study yielded important results" (recoded), "I think that one can draw useful conclusions for real life from this study," and "I think that the methodology is fundamentally useless to investigate the effects of violent video games") plus the two items "I think that the authors have no idea about video games" and "I think that the authors know a lot about violent video games" (recoded); (Cronbach's $\alpha_{confutative}$ = .82; Cronbach's $\alpha_{confirmatory}$ = .87). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*). Higher values indicate more negative evaluations.

Finally, demographic information was assessed and participants were debriefed and thanked. Completing the survey took about 13 minutes. Descriptive statistics and correlations between the evaluation variables and identification are displayed in Table 5.

Analytical Strategy and Content Analysis

Liking/disliking and posting behavior. The two central dependent variables, that is, liking/disliking and posting behavior, were analyzed via multinomial logistic regression analyses (MNLR) with identification as predictor. MNLR is suited for analyzing multiple qualitatively different categories of one dependent variable. In our case, response patterns coded with 0 served as the reference category (see Tables 3 and 4). Notably, identification with the group of gamers can have two separate effects on liking/disliking behavior: One effect refers to the question whether and to what degree identification can differentiate between participants who show a disliking bias against the confirmatory (and a liking bias in favor of the confutative) study compared to those who like both studies equally well. The other effect refers to the question whether and to what degree identification can differentiate between participants who

Table 5. Descriptive Statistics and Correlations between Variables in Study 2.

Variable	M (SD)	Correlations			
		(1)	(2)	(3)	(4)
Identification with the group of gamers (1)	2.87 (1.32)	1.00			
Negative evaluations of the confutative study (2)	3.44 (0.91)	–0.04	1.00		
Negative evaluations of the confirmatory study (3)	3.66 (1.02)	0.29***	0.15**	1.00	
Biased evaluations [a] (4)	0.22 (1.26)	0.27***	–0.60***	0.70***	1.00

Notes. $N = 655$.

[a] Difference score: negative evaluations of the confirmatory study minus negative evaluations of the confutative study

*$p < .05$

**$p < .01$

***$p < .001$.

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show a liking bias in favor of the confirmatory (and a disliking bias against the confutative) study and those who like both studies equally well. As with liking/disliking there are also two effects of interest concerning posting behavior. The first effect is whether and to what degree identification can differentiate between participants who show a posting bias against the confirmatory (and in favor of the confutative) study and those who show no posting bias. The second effect refers to the question whether and to what degree identification can differentiate between participants who show a posting bias in favor of the confirmatory (and against the confirmatory) study and those who show no posting bias. We expected that identification with the group of gamers would predict a higher likelihood of a disliking bias and a posting bias against the confirmatory study (compared to liking both studies equally well) and would predict a lower likelihood of a liking bias and a posting bias in favor of the confirmatory study (compared to liking both studies equally well).

Content analysis. Posted comments were also content analyzed. There were a total of $N = 1120$ comments (634 "contra" and 486 "pro" comments). Each relevant statement within a comment was coded according to the coding scheme shown in Table 6. All relevant statements were classified into one of five categories. The coding scheme was generated deductively upon our hypotheses and inductively by coding a subset of 10% ($n = 112$) of the comments [47]. Two research assistants blind to the hypotheses were trained with a random sample of 15% of the comments ($n = 168$). Thereafter, the two research assistants independently coded the remaining comments with a random overlap of 10% of all comments ($n = 112$), which were used to assess inter-rater reliability. The unit of analysis upon which reliability was determined was the frequency of the respective category coding for each comment. The inter-rater reliability, assessed by Krippendorff's α [48], was satisfactory in all categories, all $\alpha s > .71$ [49].

For each participant category coding frequencies of each category were pooled across the "pro" and "contra" comment within each condition (resulting in one category coding frequency for each category in each condition, see Table 6). When a participant did not post a comment into the textbox the respective frequency was set to zero. Analyses were conducted by correlating each category coding frequency with the identification measure using Spearman's ρ, since all coding frequencies were positively skewed (all skewness > 1.97). We expected that strong identifiers compared to weak identifiers would write more negative evaluative statements in the confirmatory condition and that this is not the case in the confutative study condition. The correlation coefficients were compared using Williams' test [50]. With regard to the effect opinion statements, we did not expect a difference in the confirmatory compared to the confutative study condition for strong identifiers compared to weak identifiers.

Table 6. Content Analysis Coding Scheme and Results Employed in Study 2.

Category (coding frequency)			Intercoder Reliability α	Example statement	Correlation with identification with the group of gamers (Spearman's ρ)	
					Confutative study condition	Confirmatory study condition
Evaluative statement referring directly to the study	positively evaluative (*n* = 512)		.89	"This study seems to be very sound."	.10**$_a$	–.09*$_b$
	negatively evaluative	reference to methodology (e.g., design, validity, etc.; *n* = 703)	.91	"The number of participants seems too low to draw conclusions for the population."	–.05$_a$	.16***$_b$
		reference to other issues (e.g., competence of authors, relevance, conclusion; *n* = 375)	.92	"The conclusion is nonsense."	.00$_a$	.05$_a$
Opinion statement on the effects of violent video games	violent video games have no detrimental/ positive effects or statement relativizing detrimental effects (*n* = 258)		.94	"For me, violent video games are an outlet to release pressure."	.14***$_a$	.09*$_a$
	violent video games have detrimental effects (*n* = 77)		.71	"Generally, I think that violent video games lead to aggressive behavior."	–.09*$_a$	–.03$_a$

Notes. α denotes Krippendorff's Alpha. Sample statements were translated from German. *N* = 655.

*$p < .05$

**$p < .01$

***$p < .001$. Correlation coefficients in the same row with no common lowercase subscript differ at $p < .05$ using Williams' test.

doi:10.1371/journal.pone.0117476.t006

Results

Liking/Disliking Behavior. Identification positively predicted a disliking bias against the confirmatory (and in favor of the confutative) study, $B = .38$, $SE = .07$, $p < .001$, $OR = 1.46$, 95% CI [1.28, 1.68], and negatively predicted a liking bias in favor of the confirmatory (and against the confutative) study, $B = -.35$, $SE = .10$, $p < .001$, $OR = 0.70$, 95% CI [0.58, 0.85]. In other words, strongly identified gamers are more likely to show a disliking bias against and less likely to show a liking bias in favor of the confirmatory study compared to weakly identified gamers.

Posting Behavior. Mirroring the results regarding liking/disliking behavior, identification positively predicted a posting bias against the confirmatory (and in favor of the confutative) study, $B = .16$, $SE = .07$, $p = .02$, $OR = 1.12$, 95% CI [1.03, 1.34], and negatively predicted a posting bias in favor of the confirmatory (and against the confutative) study, $B = -.36$, $SE = .09$, $p < .001$, $OR = 0.70$, 95% CI [0.59, 0.83]. In other words, strongly identified gamers (compared to weakly identified gamers) were more likely to show a posting bias against the confirmative study and less likely to show a posting bias in favor of the confirmatory study. The effects are displayed in Fig. 2.

Content Analysis. As can been seen in Table 6, identification with the group of gamers negatively predicted the number of positive evaluative statements, $r_s = -.09$, $p = .02$, 95% CI [-.16, -.01] (r_s denotes Spearman's *Rho*), and positively predicted the number of negative evaluative statements criticizing the methodology, $r_s = .16$, $p < .001$, 95% CI [.09, .24], in the confirmatory study condition. Both effects were significantly different from their counterparts in the confutative study condition, $ts > 3.07$, $ps < .003$. In other words, strong identifiers less often praised the confirmatory study and methodologically criticized it more heavily than weak identifiers did. In contrast to the

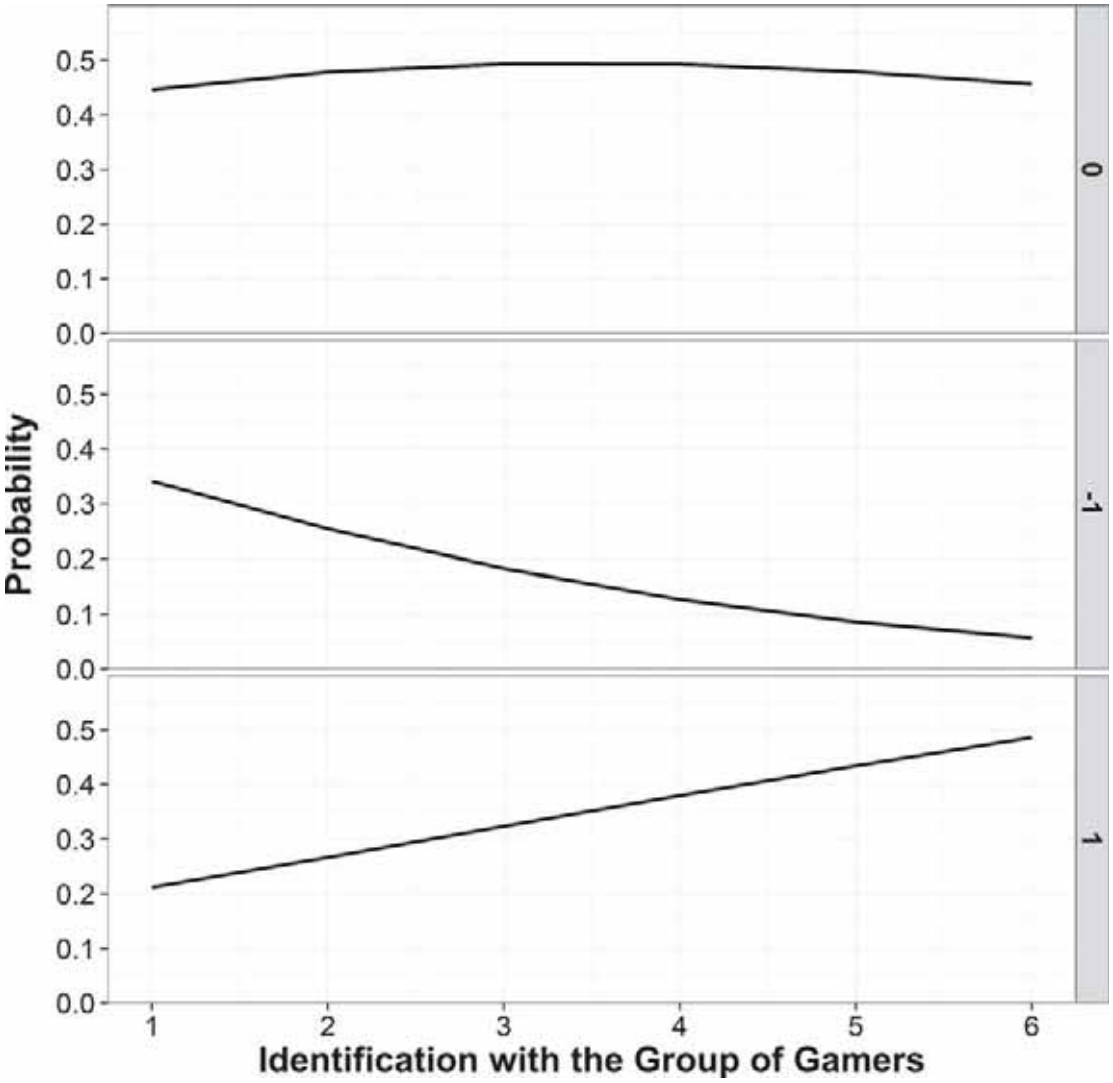

Figure 2. Probability of a posting bias against the confirmatory study ("1"), a posting bias in favor of the confirmatory study ("-1") and no bias ("0") as a function of identification with the group of gamers predicted by MNLR (Study 2).

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evaluative statements, identification did not differently predict the effect opinion statements in both conditions, *t*s < 1.01, *p*s $> .30$. In both conditions strong identifiers more often stated a no-effect opinion, $r_{s\_confutative} = .14$, $p < .001$, 95% CI [.06, .21], $r_{s\_confirmatory} = .09$, $p = .03$, 95% CI [.01, .16], and less often stated a detrimental-effect opinion $r_{s\_confutative} = -.09$, $p = .02$, 95% CI [-.17, -.01], $r_{s\_confirmatory} = -.03$, $p = .45$, 95% CI [-.10, .05]. In sum, the results of the content analysis qualify the effects found on posting behavior and demonstrate that strong identifiers particularly criticized the methodology and denied to write positive statements about a potentially threatening study within their comments.

Evaluations. In general, the confirmatory study was evaluated more negatively ($M = 3.66$, $SD = 1.02$) than the confutative study ($M = 3.44$, SD = 0.91), $t(654) = 4.50$, $p < .001$, $d = .18$, 95% CI [.10, .25] [51]. Notably, the bias against the confirmatory study (i.e., the difference between the negative evaluations of the confirmatory study and the negative evaluations of the confutative study) was predicted by the identification with the group of gamers, $r_p = .27$,

$p < .001$, 95% CI [.20, .34] (r_p denotes Pearson's r). More specifically, the stronger participants identified with the group of gamers, the more negatively they evaluated the confirmatory study, $r_{p\_confirmatory} = .29$, $p < .001$, 95% CI [.22, .36], whereas identification did not predict the evaluation of the confutative study, $r_{p\_confutative} = -.04$, $p = .26$, 95% CI [-.12, .03].

Discussion

The results of Study 2 mirror and extend our findings from Study 1. They provide additional support for our notion that strongly identified gamers are more inclined to take action against research when this research constitutes a social identity threat. When confronted with research findings that corroborate the violent-games-effect hypothesis, strongly identified gamers reacted with more "dislikes" and negative comments towards the respective research. Notably, strong identifiers particularly criticized the methodology of the confirmatory study. Furthermore, strongly identified gamers evaluated the confirmatory study more negatively than weakly identified gamers, replicating earlier findings of Nauroth and colleagues [11]. Whereas Study 2 investigated whether research that implies a social identity threat leads to science-discrediting behavioral responses from strongly identified group members, Study 3 tested whether this effect can be alleviated by alternatively affirming one's social identity.

Study 3

Study 3 aimed at investigating the psychological mechanism that explains why strongly identified group members are more likely to comment negatively on research that potentially threatens their social identity. Since strong identifiers' self-concept is more heavily based on their group membership, a social identity threat has more profound consequences for their self-concept [14,19], which, in turn, should lead to a higher motivation to restore their social identity [29]. In other words, we hypothesize that posting a negative comment in response to potentially threatening research is instrumental for restoring a positive social identity. If our reasoning was true, then achieving the same goal, that is, to restore and affirm one's social identity, via alternative means should alleviate the tendency to post negative comments. In line with this assumption, previous research has already shown that collective affirmation increases the acceptance of group-threatening information [32]. Thus, if posting negative comments actually aimed at restoring one's social identity, such posting behavior should become less likely when one's social identity has already been affirmed otherwise.

Importantly, this hypothesis is not trivial: research by Derks and colleagues [33] showed that collectively affirming group members does not alter their motivation to act collectively against a social identity threat. These authors showed that collectively affirming group members subjectively transformed the threat into a challenge and experiencing a challenge to one's social identity does not reduce collective action tendencies. This stands in contrast to our reasoning predicting a decreased tendency to act collectively after being collectively affirmed. However, the study by Derks and colleagues differs in some important aspects from the present study. Most importantly, they investigated this effect only in the performance motivation domain, in which it is reasonable to assume that a threat appraisal can be restructured into a challenge appraisal [52]. It is thus an open question whether a social identity threat emanating from scientific findings in a public debate can also be restructured in a challenge appraisal when group members were collectively affirmed. If this was the case, a collective affirmation should not lead to a decreased tendency for collective action for strong identifiers. However, if our reasoning was true, then strong identifiers should be less inclined to post a discrediting comment after being collectively affirmed.

Another alternative explanation could be that posting negative comments is motivated by personal identity threat [26]. Gamers, particularly strong identifiers, may feel personally attacked by research showing that violent video games have detrimental consequences, and these gamers may be motivated to post a negative comment in order to liberate them from the personal deprecation that accompanied such research. In other words, posting negative comments may not so much be a collective, but rather a personal issue. The present study was designed to test these two competing hypothesis against each other.

Method

Participants. The study was advertised in several German university student mailing lists (excluding the one used in Study 2). In all, 632 people started the questionnaire; 512 of them (80%) finished it successfully. Fifty-three participants were excluded from further analyses because these people indicated that they had not played any video games during the last 12 months ($n = 45$) or had more than 25% missing values on the identification measure ($n = 8$). Therefore, the final sample consisted of 459 participants (39% women). Ages ranged between 18 and 50 years ($M = 23.89$; $SD = 3.91$). One tablet computer was raffled among all participants who completed the survey.

Procedure and Measures. We used the same cover story as in Study 2: participants were told that a new blog about new research findings would be launched soon, that the first topic of this new blog would be violent video games, and that the present survey was designed to find out which studies are best suited to be presented in this blog. After this introduction, identification with the group of gamers was measured with the same items used in Study 2 (Cronbach's $\alpha = .92$; $M = 2.82$, $SD = 1.28$).

Collective vs. Self-Affirmation Manipulation. Next, participants were told that the evaluation of scientific results was affected by one's "verbal-linguistic" competence and that we therefore wanted to control for that influence (for a similar procedure, see Derks et al. [33]). Participants were asked to complete a short "verbal-linguistic" competence test, which consisted of ten anagrams that were designed to increase the likelihood that participants would feel that they were good at this. After the bogus test, participants were asked how difficult they perceived the test to be with two items ("I found the test to be difficult" and "I think that I scored well in the test"). Ratings were obtained on six-point scale (1 = *strongly disagree*, 6 = *strongly agree*). The means of both items departed significantly in the desired direction from the midpoint of the scale with $t(452) = 20.57$, $p < .001$, $M = 2.46$, and $t(457) = 14.32$, $p < .001$, $M = 4.28$.Then, participants read a summary of one study demonstrating aggression-enhancing effects of violent video games (behavioral aggression measure/confirmatory study from Study 2, see S1 Appendix). Afterwards, participants were randomly assigned to a collective affirmation, self-affirmation, or no affirmation control condition. In the *self-affirmation condition*, participants read that their personal performance on this test (relative to a representative German sample) was "above average." In the *collective affirmation condition*, participants were informed that we were not able to give them personal feedback at this point, but that–on the basis of a German representative sample–the average performance of people who regularly play video games was "above average," whereas the average performance of people who do not play video games was "below average". In the *control condition* participants received no feedback. Importantly, identification with the group of gamers did not differ between the three conditions, $F(2, 456) = 1.57$, $p = .21$.

Dependent Variable: Posting Behavior. After the affirmation manipulation participants were asked to write a "pro" (positive) or "contra" (negative) comment about the study. Each response was coded into one of four response categories: only positive comment, only negative

comment, both positive and negative comments, or no comment. Participants could also like/dislike the study and were asked for their evaluation of the study (same order and items as in Study 2). Since only identification with the group of gamers significantly predicted these variables in the same manner as in Study 2 for the confirmatory study condition, all *p*s $< .001$ and no significant condition or condition × identification interaction effects were found, all *p*s $> .18$, we refrained from presenting a detailed analysis here. However, these results replicate our findings from Study 2. We additionally content analyzed all comments in the same manner as in Study 2. We did not find any significant condition or condition × identification interaction effects on the content analytical categories, all *p*s $> .15$, and therefore also refrain from presenting a detailed analysis. However, the correlational pattern across the three conditions generally replicates our findings from Study 2 in the confirmatory study condition (see S3 Table). Finally, demographic information was assessed and participants were debriefed and thanked. Completing the survey took about 14 minutes.

Analytical Strategy. In order to analyze posting behavior, we again conducted a MNLR. Only "contra" comments were coded as +1, only "pro" comments were coded as –1, and no comments and/or "pro" *and* "contra" comments were coded as 0. The latter category served as the reference category. We expected that identification with the group of gamers positively predicts negative posting behavior in the control and self-affirmation condition, but not in the collective affirmation condition. Statistically speaking, we expected an affirmation × identification interaction effect. The three experimental conditions were effect-coded with *effect1* representing the difference between the self-affirmation condition and the grand mean (effect1: self-affirmation = 1, collective affirmation = 0, control = −1), and *effect2* representing the difference between the collective affirmation condition and the grand mean (effect2: self-affirmation = 0, collective affirmation = 1, control = −1), and identification was centered prior to computing product terms [43]. Simple effects of significant interaction effects were tested by conducting binary logistic regressions for the respective condition in contrast to the control condition (i.e., collective affirmation vs. control or self-affirmation vs. control) with identification as the predictor and posting behavior as the dependent variable (i.e., negative posting behavior vs. reference category or positive posting behavior vs. reference category).

Results

First, we tested the full model with posting behavior as the criterion and identification (mean-centered), effect1, effect2, identification × effect1, and identification × effect2 as predictors. Positive posting behavior was only predicted by identification, $B = -.32$, $SE = .12$, $p = .009$, $OR = 0.73$, 95% CI [0.58, 0.93]: the stronger the identification with the group of gamers, the lower the likelihood of posting a positive comment, irrespective of the affirmation condition. No other effects were significant on the 5% level. Negative posting behavior was also predicted by identification, $B = .19$, $SE = .09$, $p = .045$, $OR = 1.20$, 95% CI [1.00, 1.44] and by effect1 (the self-affirmation effect), $B = -.38$, $SE = .16$, $p = .02$, $OR = 0.69$, 95% CI [0.50, 0.93]. Strongly identified participants were more likely to post a negative comment than weakly identified participants; additionally, self-affirmed participants were less likely to post a negative comment than non-affirmed participants. However, the effect of identification was qualified by the hypothesized identification × effect2 interaction effect, $B = -.39$, $SE = .12$, $p = .001$, $OR = 0.67$, 95% CI [0.53, 0.86] (see Table 7). Simple slopes analysis was conducted via binary logistic regressions. As expected, the effect of identification was significant in the control condition, $B = .54$, $SE = .18$, $p = .003$, $OR = 1.71$, 95% CI [1.20, 2.42], but not in the collective affirmation condition, $B = -.20$, $SE = .14$, $p = .15$, $OR = 0.82$, 95% CI [0.62, 1.08]. In other words, strong identifiers were more likely to post a negative comment in the control condition, thus replicating the results of Study 2. However, when

Table 7. Results of Multinomial Logistic Regression Analysis (Study 3).

	Posting behavior	
	Positive	**Negative**
Intercept	–0.37*	0.56***
Identification with the group of gamers	–0.32**	0.18*
Effect1	–0.34	–0.38*
Effect2	–0.23	–0.01
Identification × Effect1	–0.08	0.01
Identification × Effect2	–0.33	–0.39**

Notes. $N = 459$.
*$p < .05$
**$p < .01$
***$p < .001$. Reference category: no posting or positive and negative posting.

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collectively affirmed, strong identifiers were not more likely to post a negative comment about the confirmatory study anymore. Importantly, the identification × effect1 interaction effect was not significant ($p = .91$), which implies that self-affirmation did not alleviate strong identifiers' likelihood of posting a negative comment about the study. The effect of identification on negative posting behavior in each of the three affirmation conditions is depicted in Fig. 3.

Discussion

Results from Study 3 replicate and extend the findings from Study 2. As in Study 2, strong identifiers were more likely than weak identifiers to post a negative comment against a potentially threatening research finding. However, when collectively affirmed, identification did no longer predict posting behavior. This finding provides evidence that writing a science-discrediting comment serves an affirmative goal: by writing a critical and negative comment against a threatening research finding, strong identifiers aim to restore their devalued social identity. Self-affirmation, on the other hand, did not interact with identification. However, self-affirmation led to a decrease in negative comments regardless of the participants' degree of identification, thereby replicating a common finding from the self-affirmation literature [28]. This strengthens our argument that a social identity threat triggers a need for affirmation–particularly for strong identifiers–and that posting a negative comment appeases the need for affirmation. Importantly, we were able to show that–in the case of a social identity threat emanating from scientific findings–collectively affirming group members actually decreases collective action tendencies. This stands in contrast to the finding by Derks and colleagues [33] who found no effect of collective affirmation on collective action tendencies in the domain of performance and achievement. Thus, the effect of a collective affirmation on collective action tendencies seems to depend on the threat domain and on the type of collective action (online vs. offline).

General Discussion

Research on science communication has grown during recent years. This research has mainly focused on people's attitudes toward science and influencing factors. Much less research has been devoted to the question of whether the same factors explaining people's attitudes also lead to behavioral consequences and how such behavioral inclinations can be motivationally explained. The present research aimed to fill this gap. We focused on posting science-discrediting

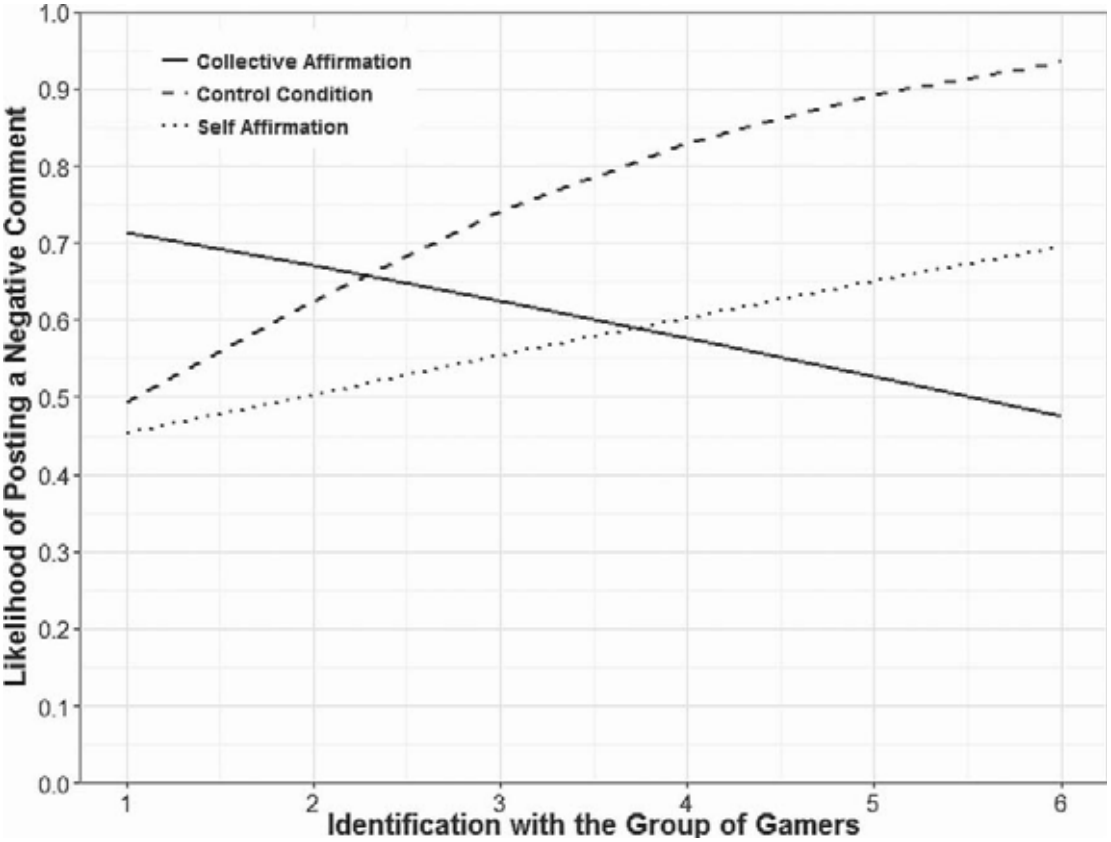

Figure 3. Likelihood of posting a negative comment against the confirmatory study vs. reference category (negative and positive or no comment) by identification with the group of gamers by condition predicted by binary logistic regressions (Study 3).

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online comments as a possible behavioral response toward social identity threat. The three studies reported in this article provide consistent support for our theoretical argument that posting science-discrediting comments in the online realm can be explained by social identity theory. All three studies consistently indicate that strongly identified group members more often write science-discrediting comments when the research is threatening to their social identity. Furthermore, Study 2 and 3 revealed that strong identifiers particularly aimed at impairing the credibility in the methodology of potentially threatening research. Finally, Study 3 demonstrated that posting negative and critical comments against threatening research is motivated by a need to restore one's social identity.

These findings provide evidence for our assumption that research, when it implies a threat to one's social identity, elicits critical communication among strongly identified group members in Internet forums, social networks, or online discussions, and that this communication is directed at restoring a positive social identity. On a theoretical level, our research provides new insight into the processes and factors that promote science-opposing actions by laypersons. In cases in which groups are the focus of research, our findings suggests that it is not only the quality of research that leads people to publicly criticize certain research results, but also the implications of the research for one's social identity in conjunction with the degree to which people feel connected to the in-group. On an applied level, our research has immediate

implications for the question which factors undermine the societal acceptance of scientific findings and which factors may motivate people to actively oppose such findings.

Social Identity and Online Collective Behavior

The discharge of negative and hostile opinions on the Internet is often attributed to disinhibition effects of the online environment [53] or simply to an epidemic opinion spreading in the online social network cluster [54,55]. Our research challenges these perspectives and suggests that posting science-discrediting online comments can be regarded a form of collective action. The SIDE model and social identity theory offer immediate and well-founded predictions for online (collective) behavior. As shown in all three studies, people were motivated to write a discrediting comment when they identified strongly with their in-group, which demonstrates that identity concerns are an important factor in order to understand online behavior. Concerning individual behavior, this perspective is supported by Toma and Hancock [29]. These authors showed that people used Facebook for self-affirmative concerns after their ego was threatened. Our results conceptually extend Toma and Hancock's findings by showing that after a social identity threat people also make use of the respective online features in order to collectively affirm their social identity (Study 3).

However, we would not argue that identity concerns are the only motivation behind science discrediting behavior. Being collectively affirmed did indeed diminish the likelihood to discredit science, but it did not eliminate it entirely (see Fig. 3). Other motivations might be particularly influential when the respective scientific result has immediate implications for policy making (i.e., in socio-scientific debates). For example, in the case of the violent video games debate, strong identifiers might also fear sale bans or accessibility restrictions being based upon research demonstrating a games-aggression link. In this case posting a negative comment might be also motivated by the intention to prevent research findings from affecting policy. Whereas immediate social identity concerns are possibly the spontaneous motivational component of discrediting threatening science, trying to prevent research results from affecting policies might be the more strategic component. In fact, strategic considerations have been shown to be very influential for how people express their social identity in public (see [56]). Thus, future research might investigate which other factors, besides social identity concerns, motivate science-discrediting behavior.

The new features of the Web 2.0 also give rise to the question whether and to what degree online collective action is truly something qualitatively different then offline collective action. In order to conceptually extend the typology of online collective action, Van Laer and Van Aelst [57] distinguished between low-threshold (i.e., low-risk, low-cost) collective actions (e.g., joining and liking a group's Facebook page, signing online petition, posting comments) and high-threshold (i.e., high-risk, high-cost) collective actions (e.g., "hacktivism," establishing and maintaining a protest website). Whereas it seems reasonable to assume that high-threshold online collective action and classical offline collective action are more likely to have similar underlying mechanisms [25] low-threshold online collective action is different. For instance, Schuman [58] demonstrated that low-threshold online collective action actually impedes offline collective action: people who participate in low-threshold online collective action are less likely to participate in offline collective action, whereas this was not the case for high-threshold online collective action. Furthermore, low-threshold online collective action might also be generally perceived as less effective than offline collective action [59] implying that the effect of efficacy as predictor of collective action tendencies [17] might be modulated by the particular setting. These and other issues are of high interest for theory building in collective action research since it seems likely that low-threshold online collective action is going to become more frequent the more people make use of the new communicational features of Web 2.0.

Limitations and Suggestions for Future Research

The present research dealt with the violent video games debate. By focusing on one debate, we cannot be sure whether our conclusions are applicable to other cases in which groups are affected by research results as well. However, since we based our predictions on general principles of the social identity theory (i.e., social identity threat and social identification), which have been shown to be applicable to a whole range of social groups and intergroup phenomena [60], our results should also be applicable to other instances in which social groups are affected by research. Nonetheless, future research should investigate our predictions in other instances in order to test whether our findings can be generalized beyond the violent video games debate. Other examples in which our research results might be applicable are men discrediting research on sexism, unionists on research investigating potential adverse effects of unions on the economy, or vegetarians questioning the validity of research showing negative health effects of a vegetarian diet.

Our findings provide first evidence for social identity concerns not only influencing individual attitudes towards science, but furthermore motivating science-discrediting behavior on the Internet (and elsewhere). We will now discuss two open questions, which arise from our findings, and we hope that this discussion will stimulate further research on these topics.

Target of the communication. In the experimental setup of Studies 2 and 3, participants were told that the studies were conducted in order to identify suitable scientific studies for an online blog. One could expect that the content, tone, or negativity of the comment changes as a function of whom it is directed at: the public (or third parties), the out-group, or the in-group [56]. Comments directed at the public or third-parties should be particularly persuasive (i.e., calling the credibility of the research into question) in order to prevent others from getting a negative impression about the in-group (like in our studies). In contrast, comments directed at the out-group (in our case, laypersons and scientists arguing that violent video games are harmful) should be particularly derogative and offensive (cf. the example cited at the beginning of this article), whereas an in-group directed comment should aim at instigating collective action [22]. The latter case is particularly interesting since recent research shows that online comments effectively influence other in-groups members' evaluation of information on the Web. Walther and colleagues [61] demonstrated that people who watched a YouTube video were more strongly influenced by the valence of the posted comments toward this video when they identified strongly with the peers posting the comments. This finding indicates that posting online comments can be an effective way to influence other in-group members' opinions. From a collective action perspective, this finding suggests that online comments can be effective in motivating other in-group members to take action against threatening information. This also resonates with work by Postmes and Brunstig [59] who showed that activists perceived the mobilizing potential of the Internet as its biggest advantage. Thus, it would be worthwhile to investigate whether the content, tone, or negativity of the comment changes as a function of the target of the comment.

Escalation of negative posts. A somewhat related question that future research should address is how the escalation of negative posts sometimes observed in social networks and Web forums ("online firestorm," [55]) can be explained. Why do some people write derogatory online comments even though several people had already posted a similar comment on the same issue before? These phenomena are particularly interesting since they stand in contrast to research findings suggesting that online social influence effects rather lead to a positivity bias and not to negative downward spirals [62]. However, if posting a comment was not only motivated by the desire to express one's opinion, but rather by supporting the in-group, particularly strong identifiers should be prone to post negative comments even though others had done so already [63]. Like demonstrating on the street is more influential the more protesters are

involved, posting discrediting online comments might also be perceived as more influential the more commentators are joining in. This interpretation is also in accord with findings that the higher the perceived efficacy of a collective action, the more likely collective action is taken [17]. This might even be enhanced by an expectancy that other users react affirmatively towards one's negative comment when the group consensus was clearly and numerously expressed before. Thus, potential positive reactions from other commentators towards one's own comment might be an additional affirmative source (besides the affirmative effect of one's own comment). It would therefore be interesting to test these predictions in a simulated online environment in which people have the possibility to post comments and to react directly toward comments made by other participants.

Science Communication and a Public Engagement with Science

The findings of this article contribute to the science communication literature in various ways. Most importantly, our findings offer a theoretical explanation for why certain scientific findings sometimes face a broad societal opposition: science-discrediting comments made by in-group members might persuade others to dismiss scientific findings as invalid [64,65]. Computer-mediated word-of-mouth has been shown to be highly persuasive [66,67]. In a real-life scenario of the cover story employed in Studies 2 and 3, the science-discrediting comments made by strongly identified group members might have persuaded the blog editors to dismiss the threatening articles from the blog. Such a persuading effect should be particularly intended when the comment is specifically directed at the general public or third-parties (see above). Notably, Anderson and colleagues [3] found that negative blog comments indeed have a persuading effect on laypersons' perception of scientific findings and technologies. These authors found that uncivil blog comments polarized risk perceptions of nanotechnology depending on readers' support for nanotechnology. Uncivil blog comments increased the risk perception of people opposing this technology and decreased the risk perception for people who were in favor of it. The findings of Anderson and colleagues therefore suggest that negative comments can impair the credibility of a scientific finding or an emerging technology. Thus, science-discrediting comments might actually lead parts of the public to question the research's credibility and validity.

Conclusions

The present research sheds light on why people post science-discrediting comments in blogs, social networks, and Web forums. In three experiments, we showed that identification with the group affected by research findings increases the likelihood to post a science-discrediting comment when the finding is potentially threatening to one's social identity, and that these comments were aimed at reaffirming the threatened social identity. Theoretically, our research shows that the social identity approach is useful to explain hostile behavior in the online realm and the public engagement with science. On a more applied level, our research demonstrates why certain scientific findings sometimes face a broad societal opposition.

Supporting Information

S1 Appendix. Summaries used in Study 2.
(DOCX)

S1 Table. Separate Contrast Analysis for the Confutative and the Confirmatory Study Condition with Identification as the Dependent Variable and Posting Behavior as the Independent Variable.
(DOCX)

S2 Table. Separate Contrast Analysis for the Confutative and the Confirmatory Study Condition with Identification as the Dependent Variable and Liking/Disliking Behavior as the Independent Variable.
(DOCX)

S3 Table. Content Analysis Coding Scheme and Results Employed in Study 3.
(DOCX)

S1 Data. Datasets of Study 2 and Study 3.
(ZIP)

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Author Contributions

Conceived and designed the experiments: PN MG JB TR. Performed the experiments: PN. Analyzed the data: PN MG. Wrote the paper: PN MG JB TR.

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5 Manuscript #3

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The effects of social identity threat and social identity affirmation on laypersons' perception of scientists

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Abstract

Public debates about socio-scientific issues (e.g., climate change or violent video games) are often accompanied by attacks on the reputation of the involved scientists. Drawing on the social identity approach, we report a minimal group experiment investigating the conditions under which scientists are perceived as non-prototypical, non-reputable, and incompetent. Results show that in-group affirming and threatening scientific findings (compared to a control condition) both alter laypersons' evaluations of the study: in-group affirming findings lead to more positive and in-group threatening findings to more negative evaluations. However, only in-group threatening findings alter laypersons' perceptions of the scientists who published the study: scientists were perceived as less prototypical, less reputable, and less competent when their research results imply a threat to participants' social identity compared to a non-threat condition. Our findings add to the literature on motivated science reception research and have implications for understanding the public engagement with science.

[148 words]

Keywords: Science Communication, Motivated Science Reception, Social Identity Threat, Public Engagement with Science, Social Identity Affirmation, Group Perception, Subtyping

The effects of social identity threat and social identity affirmation on laypersons' perception of scientists

It has never been easier for laypersons to actively engage with science. First, the Internet offers an incredible amount of scientific knowledge accessible for everyone and from everywhere. Second, laypersons can easily get in touch with scientists by commenting in blogs or on websites scientists are writing for. Third, motivated and interested laypersons can actively engage in scientific data collection (Hand, 2010) or even financially promote research projects they would like to see realized[1]. Some advocates promoting a comprehensive public engagement with science even suggest that laypersons should participate in making decisions about which research project deserves public funding and which does not ("citizen science", see Irwin, 2001).

Although such developments are, in principal, highly welcomed in order to improve the general public's attitudes toward and interest in science, they rely on the assumption that the general public possesses both the willingness and the capacity to evaluate research projects mainly on the basis of their scientific quality and on the qualification of the researchers. The whole idea of "citizen science" could backfire if public perceptions and evaluations of science and scientists were strongly influenced by factors that are irrelevant to the objective quality of a scientific study such as laypersons' attitudes, beliefs, or social

identities. Indeed, a vast body of evidence from social psychology demonstrates the impact of various biases when laypersons evaluate scientific evidence (cf. Kunda, 1990). Recent research on motivated science reception investigated how personal beliefs (Greitemeyer, 2014; Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012; Munro, 2010; Scheufele, Corley, Shih, Dalrymple, & Ho, 2009), group membership (Bliuc et al., in press; Morton, Haslam, Postmes, & Ryan, 2006; Nauroth, Gollwitzer, Bender, & Rothmund, 2014, 2015), or knowledge about a topic (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008) can lead to a biased evaluation of scientific findings. For instance, findings that call personally important beliefs into question are evaluated more negatively than results confirming these beliefs (Greitemeyer, 2014). Such belief-inconsistent scientific evidence can even trigger a fundamental critique of science in general such that a particular topic is considered impossible to be studied scientifically at all (Munro, 2010). In a similar vein, Nauroth et al. (2014, 2015) demonstrated that scientific evidence jeopardizing a positive aspect of a cherished social group ("social identity threat") leads laypersons to reject the respective evidence.

Most of this research has focused on the factors altering laypersons evaluation of scientific evidence. By contrast, laypersons' perceptions of the researchers who published this evidence have attracted much less interest. This is remarkable since the way we

perceive others significantly influences what we think about (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005) and how we behave toward them (Dijksterhuis & Bargh, 2001). For instance, when laypersons perceive a scientist to be reputable and an expert in his or her field, they are more likely to read their papers (Winter & Krämer, 2012, 2014). Consequently, how we perceive scientists should almost certainly also influence how we evaluate and engage with scientific evidence and with science in general: suspecting a researcher to have violated standards of good scientific practice (objectivity, competence, methodological rigor etc.) may promote a negative engagement with science (i.e., by posting negative comments on a website when reading about the researcher's work), whereas perceiving researchers as objective and unbiased may promote a positive engagement with science (i.e., by donating money for their research). In other words, knowing more about the conditions under which laypersons perceive scientists to be upright and competent helps understand — and eventually prevent — negative forms of public engagement with science.

Building upon the burgeoning literature on social influences in motivated science reception (see Maier, Rothmund, Retzbach, Otto, & Besley, 2014), we argue that social identity threat (Tajfel & Turner, 1986) and social identity affirmation (Ellemers, Spears, & Doosje, 2002) not only bias people's evaluation of research findings but also their

perception of the researchers who are publishing these findings.

Social Identity Threat and Affirmation

To date, science communication research mainly rests on the assumption that motivated science reception is rooted in individual beliefs, attitudes, or knowledge (e.g., Sinatra, Kienhues, & Hofer, 2014). More recent research, however, suggests that motivated science reception may also be related to social identity concerns (Postmes, 2015). A particular scientific finding such as the finding that a vegetarian diet has positive consequences for one's health, not only affirms a vegetarian's personal beliefs and values but also his or her social identity – the self-worth one derives from being a member of a social category (Tajfel & Turner, 1986); in this case, being a vegetarian. By contrast, a study demonstrating negative health effects of a vegetarian diet should implicitly threaten a vegetarian's social identity. One way to cope with that threat would be to devalue the threatening study (De Hoog, 2013).

Morton et al. (2006) and Nauroth et al. (2014, 2015) found empirical support for these assumptions. Morton et al. (2006) showed that participants evaluated a study as more "scientific" and its research topic to be more eligible (i.e., deserving more government funding) when the findings affirmed their gender identity. They concluded that scientific findings are more likely to be perceived as credible and plausible to the extent that they

provide people with a positive sense of their social identity. Complementing these results, Nauroth et al. (2014) showed that research findings implicitly threatening one's social identity led participants to devalue these findings. Strongly identified video game players negatively evaluated a scientific study when it found that playing these games increases players' aggressive tendencies (compared to a study which showed no negative effects of playing violent video games).

It is plausible to assume that social identity-affirming and threatening findings not only influence laypersons' evaluation of the research, but also their perceptions of the respective researchers. Notably, two opposing hypotheses can be derived from social identity theory (Tajfel & Turner, 1979) and from the literature on group perception regarding *how* social identity threat and affirmation may alter people's perception of researchers. One hypothesis, which we will refer to as the "homogeneity hypothesis," builds upon group perception research (e.g., Ostrom & Sedikides, 1992). This research suggests that threatening research results lead to a more homogeneous perception of the entire scientific community, whereas affirming research results do not alter people's homogeneity perceptions. The other hypothesis, which we will refer to as the "subtyping hypothesis," argues that being confronted with threatening research results leads people to cognitively exclude the respective authors from the scientific community, whereas

affirming research results leads people to perceive the authors as more prototypical. Both hypotheses also allow to derive predictions regarding laypersons' perception of the competence and the reputability of the researchers who published threatening vs. affirming research results.

The Homogeneity Hypothesis

Group perception research indicates that people often generalize their impression about one or a few out-group members to the entire out-group (Crawford, Sherman, & Hamilton, 2002; Hamilton & Gifford, 1976; Mackie, Allison, Worth, & Asuncion, 1992; Risen, Gilovich, & Dunning, 2007; Rothbart, Fulero, Jensen, Howard, & Birrell, 1978). Negative behaviors performed by members of non-familiar out-groups are particularly likely to be generalized to the entire out-group (Hamilton & Gifford, 1976). Subsequent research supported this contention (e.g., Hamilton, Dugan, & Trolier, 1985; Risen et al., 2007) and demonstrated that negative behaviors are also more readily generalized than positive behaviors (Barlow et al., 2012; Stark, Flache, & Veenstra, 2013). For the average layperson, the scientific community represents a non-familiar out-group with which they seldom interact. Thus, when laypersons are confronted with researchers publishing threatening research findings (a "negative" behavior; Nauroth et al., 2014), laypersons might generalize their impressions about these researchers to the entire scientific

community. Conversely, these researchers should be perceived as rather typical members of the scientific community.

People perceive threatening out-groups to be more homogeneous than non-threatening out-groups (Brewer, Weber, & Carini, 1995; Corneille, Yzerbyt, Rogier, & Buidin, 2001; Dépret & Fiske, 1999; Rothgerber, 1997; Wilder, 1978). For instance, Rothgerber (1997) showed that students perceive more intragroup similarities among students from a rivaling university when students were told that out-group students were negatively biased in judging essays of in-group students. Applied to the case where laypersons see themselves confronted with a threatening scientific study, they may perceive researchers of the respective scientific community as rather homogenous. Taken together, the homogeneity hypothesis for social identity threat states that being confronted with threatening (vs. non-threatening) research results leads to higher homogeneity perceptions of the respective scientific community and to higher typicality perception of the researchers who published the research results.

In contrast to threatening research, social identity-affirming research should not affect laypersons' out-group perceptions (nor their typicality perceptions). Since increased homogeneity perceptions are assumed to foster in-group members' defenses against negative social identity implications, group members should not alter their out-group

perception when being confronted with non-threatening groups (Dépret & Fiske, 1999; Wilder, 1978). This is in line with results from Rothgerber's (1997) first study. In this experiment, he incorporated a benevolent out-group condition (besides the threatening out-group condition; see above) and showed that a benevolent out-group (i.e., out-group students judging in-group students' essays very good) did not alter homogeneity perceptions compared to a control group. Thus, a scientific result affirming one's social identity should have no effect on homogeneity (or typicality) perceptions of the scientific community.

The Subtyping Hypothesis

The homogeneity hypothesis rests on the assumption that researchers publishing threatening scientific findings are perceived as representative prototypes of the scientific community. However, this might not necessarily be the case. Since laypersons are motivated to re-establish a positive social identity after being confronted with threatening research findings (Nauroth et al., 2015), one way to maintain a positive social identity in face of threatening scientific evidence could be to dismiss a single threatening finding – and the researcher(s) who published this finding – as dissenting and not representative. This prediction would be in line with research on subtyping (Weber & Crocker, 1983). Subtyping describes the phenomenon that members of an out-group who disconfirm the

group stereotype are sometimes cognitively excluded from the respective social category (Riek, Mania, & Gaertner, 2013). Applied to the case where laypersons read about a threatening scientific finding, the researchers who published this finding may be excluded from the social category of scientists. The key variable indicating subtyping is perceived prototypicality (see Richards & Hewstone, 2001): group members being perceived as non-prototypical are the ones also being cognitively excluded from the respective social category (i.e., subtyped). Thus, researchers publishing threatening findings should be perceived less prototypical members of the scientific community than researchers publishing non-threatening findings. Taken together, the subtyping hypothesis for social identity threat states that being confronted with threatening (vs. non-threatening) research results leads to reduced typicality perceptions of the researchers for the respective scientific community.

The logic underlying the subtyping hypothesis also allows for predictions concerning affirmative research results. When laypersons downplay a threatening research finding in order to protect their social identity, they may also exaggerate the importance of an affirming research finding in order to boost their social identity. More precisely, the identity-enhancing effect of an affirming research result should be strongest when people also believe in its validity and perceive the researchers as prototypical and reputable. Thus,

when being confronted with an identity-affirming research result, laypersons should be inclined to perceive the researchers as prototypical for the scientific community. This prediction would also be in line with the results of Morton et al. (2006), who showed that identity-affirming scientific results lead to more positive research evaluations.

The Present Research

Summing up, the homogeneity hypothesis and the subtyping hypothesis predict distinctly different patterns regarding the effect of identity-threatening and identity-affirming research results on laypersons' perceptions of researchers. According to the homogeneity hypothesis, people should perceive researchers who publish identity-threatening research results as more typical for the respective scientific community and perceive the community as more homogeneous compared to a non-threat control condition. However, identity-affirming research results should not alter typicality or homogeneity perceptions compared to a control condition. By contrast, the subtyping hypothesis predicts that people perceive researchers who publish identity-threatening research results as less typical for the respective scientific community compared to a control condition, whereas homogeneity perceptions of the (remaining) scientific community should remain unaffected. However, identity-affirming research results should lead to higher typicality perceptions compared to a control condition in order to enhance their effect on one's social

identity.

Both hypotheses have immediate implications for how competent and reputable scientists might be perceived. Whereas the homogeneity hypothesis implies that threatening (and affirming) research results should not alter laypersons' assessment of competence and reputability, the subtyping hypothesis implies that laypersons perceive scientists publishing threatening (vs. affirming) research results as less (vs. more) competent and reputable (in line with the predicted decreased [vs. increased] typicality perception). Thus, we also measured laypersons' competence and reputation assessments in order to shed light on possible downstream consequences of researcher typicality perceptions.

Additionally, we set out to replicate the effects of affirming and threatening research studies on the evaluation of these studies found by Morton et al. (2006) and Nauroth et al. (2014, 2015). These authors investigated the biasing effects of social identity threat and affirmation only in one context (i.e., the effect of social identity threat was only investigated in the context of research on violent video games and the effect of social identity affirmation was only investigated in the context of research on gender differences). In order to test whether their findings reflect a general principle or are context specific, we tested their predictions in a minimal group paradigm (Tajfel, 1970). A minimal group paradigm categorizes individuals on the basis of arbitrary distinctions (in our case a faked

psychological test determining one's "association style"), thereby being able to experimentally manipulate individuals' group affiliation. Arbitrary categorizations are preferable over "naturalistic" categorizations because socially shared stereotypes and intergroup dynamics in natural group memberships could potentially confound social identity effects. Furthermore, the minimal group paradigm is well-established in social psychology in general (e.g., Diehl, 1990) and in social perception research in particular (e.g., Rubin, Hewstone, & Voci, 2001).

Method

Procedure

Participants arrived in the lab for an experiment entitled „How do people perceive science?" After participants were provided with an overview of the experiment and a set of general instructions, informed consent was obtained. Each participant was seated in an individual cubicle and all further instructions and the questionnaire were delivered via computer. In order to manipulate participants' group membership, participants were ostensibly categorized as either exhibiting a "holistic" or a "detailed" association style (see Scheepers & Ellemers, 2005) on the basis of a word- and figure-association task. Participants had to decide which word/figure out of four presented words/figures subjectively stuck out and did not fit in well. Participants were told that their association

style would be assessed by the computer. All participants were informed that they exhibited a "holistic association style." After receiving this feedback they were asked to read a randomly chosen article on association styles that had ostensibly been published recently in a scientific journal. Depending on experimental conditions, they received either (a) an identity-threatening, (b) a neutral (control), or (c) an identity-affirming article. The manipulation material was a (faked) typical first page of a research article consisting of a short presentation of the author (name, title, university affiliation, research interest, and picture) and the abstract. Whereas the author description was held constant across all conditions, the abstract was altered depending on conditions. In the *threat* condition participants read about an experiment showing that people with a holistic association style are less prosocial compared to people with a detailed association style. In the *affirmation* condition people with a holistic association style were found to be more prosocial, and in the *control* condition people with a holistic association style did not differ from people with a detailed association style regarding their prosocial behavior.

Immediately after reading the article, participants had to answer several multiple choice comprehension questions and were only allowed to proceed when these questions were answered correctly. This was done in order to ensure that they had read the article conscientiously and attentively.[2]

Measures

Participants were asked to *evaluate the study* and the *competence of the author* (adapted from Nauroth et al., 2014, 2015). Participants evaluation was assessed with six items ("I think that this study was a waste of public money" (recoded), "I think that the results of this study are unambiguous," "I think that this study yielded important results," "I think that one can draw useful conclusions for the real life from this study," "I think that the methodology is fundamentally useless to investigate the effects of an association style" (recoded), and "I think the results of the study are implausible" (recoded); Cronbach's α = .76) and the competence of the author with four items ("I think the author knows a lot about association styles and information processing," "I think that the author is not very competent" (recoded), "I think that the author just finds what he wanted to find" (recoded), and "I think the author has no idea about human information processing and its consequences" (recoded); Cronbach's α = .75). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*) with higher values indicating a more positive evaluation of the study and a positive assessment of the competence of its author.

Next, participants were asked to indicate the degree to which they think that scientists working in the field of association styles share the opinion that a holistic association style has positive or negative consequences (*predominant opinion in the*

scientific community). This was done by varying the sizes of two circles (one for the number of scientists having the opinion that a holistic association style has negative consequences and the other for the number of scientists having the opinion that a holistic association style has positive consequences); the bigger the circle the more supporters the respective opinion had. The pair of circles varied in seven graduations from 1 = clear majority for negative consequences (i.e., very large circle for the number of scientists believing in negative consequences and very small circle for the number of scientists believing in positive consequences) to 7 = clear majority for positive consequences (i.e., very large circle for the number of scientists believing in positive consequences and very small circle for the number of scientists believing in negative consequences). This item served as a manipulation check; it indicates the degree to which participants believed the study results. Participants in the affirmation condition should perceive positive effects to be the dominating scientific opinion, participants in the threat condition should perceive negative effects to be the dominating scientific opinion, and participants in the control condition should perceive negative and positive effect opinions as equally prevalent.

Homogeneity of the scientific community was assessed with the item "How similar are the members of the scientific community among each other?" (ranging from 1 = *extremely different* to 6 = *extremely similar*).

Typicality of the author was assessed both directly and indirectly. Direct typicality was measured with two scales, *typicality of the author* and *typicality of the author's opinion*. Typicality of the author was assessed with two items ("How typical is the author for the scientific community in general?" ranging from 1 = *not at all typical* to 6 = *extremely typical* and "How similar is the author to the scientific community?" with a response scale varying the distance between a small circle for the author and a large circle for the community ranging from 1 = author circle far outside the community circle to 7 = author being exactly in the middle; Cronbach's $\alpha = .54$; see Riek et al., 2013, and Schubert & Otten, 2002). *Typicality of the author's opinion* was assessed by four items ("How many percent of the scientific community share the opinion of the author?" implemented via a sliding bar returning integer percentages ranging from 0-100%, as well as three items using Likert-type responses: "The results of the author reflect the general opinion of the scientific community," "I think that for this research the author used untypical methods and therefore obtained untypical results" (recoded), and "The author and his results rather constitute a minority within the scientific community" (recoded) ranging from 1 = *not at all true* to 6 = *very much true*; Cronbach's $\alpha = .76$). Due to different response scales we *z*-standardized responses prior to computing the respective composite. High values on the direct measures of typicality indicate a high typicality of the author for the scientific community.

In order to include an unobtrusive measure of typicality, we additionally assessed typicality *indirectly*. Following Wenzel, Mummendey, Weber, and Waldzus (2003), participants rated the author and the scientific community separately on 15 traits using 7-point semantic differentials (ranging from -3 to +3). Ten of these traits were science-related (e.g., unscientific – scientific, subjective – objective, stupid – intelligent) and the remaining five were filler traits (e.g., unattractive – attractive, indifferent – passionate). We computed Euclidean distances between the author and the community on the science-related traits as a standard measure of profile dissimilarity (see Machunsky, Meiser, & Mummendey, 2009). The obtained Euclidian distances were *z*-standardized and multiplied with -1, such that high values indicate a high typicality.

Furthermore, participants were asked to indicate the *reputation of the author* within the scientific community on four items ("I think that the author is highly reputable within the scientific community," "I think that the author is perceived as a highly reputable scientist in the eyes of his colleagues," "I think that the author and his research are fully integrated in the scientific community," and "I think that the author has a lot of influence and power within the scientific community," Cronbach's $\alpha = .84$). Response scales ranged from 1 (*not at all true*) to 6 (*very much true*) with higher values indicating a higher reputation within the community.

Additionally, participants were asked how strongly they identified with the group of people exhibiting a holistic association style ("I identify with the group of holistic-associating people;" response scales ranging from 1 = *not at all true* to 6 = *very much true*; see Postmes, Haslam, & Jans, 2013) and how strongly they feel threatened by the research results in their social identity as a holistic-associating person ("I feel that these results threaten my identity," "As a holistic-associating person I take offense by these results," and "As a holistic-associating person these results upset me;" response scales ranging from 1 = *not at all true* to 6 = *very much true*; Cronbach's $\alpha = .78$). These two measures served as additional manipulation checks. We expected that identification as a holistic-associating person should only be increased in the affirmation condition and threat perceptions should only be increased in the threat condition.

Finally, demographic information was assessed. Upon completion of the study, which took about 30 minutes, participants were debriefed and thanked. The mean and standard deviations of all measured variables can be found in Table 1 and their intercorrelations in Table 2.

Power Analysis and Participants

Nauroth et al. (2014) and Morton et al. (2006) each obtained approximately medium effect sizes between their control and experimental conditions on their evaluative measures.

Since we conducted a laboratory study (which should lead to less noise in our data compared to these previous studies), we expected medium to large effects on our dependent variables (Cohen's $d = .65$). In order to obtain a power of .80 when comparing each experimental condition with the control group, power analysis indicated a minimum sample of $N = 117$ (G*Power 3, see Faul, Erdfelder, Lang, & Buchner, 2007). As suggested by Oppenheimer, Meyvis, and Davidenko (2009), the survey also comprised attention checks in the latter part of the experiment ("If I complete this questionnaire attentively and focused, I do not respond to this item," and "My association style is [holistic, detailed]"). Based on the drop-out rates reported by Oppenheimer et al. (2009), we expected a failure rate of 25% on these checks, and therefore tried to sample at least 156 participants.

In total, 160 students (studying various subjects: 59% social sciences [including psychology], 20% natural sciences, 11% humanities, 10% teacher training) agreed to participate and either received course credit or six Euro. Twenty-two participants (14%) failed the attention checks leading to a final sample of 138 participants (67% female, M_{age} = 24, $SD_{age} = 2.99$)[3], which well exceeds the minimal sample size indicated by the power analysis.

Results

We tested our hypotheses by comparing the control condition to both experimental

conditions (i.e., affirmation vs. threat) on each dependent variable employing a-priori contrasts (contrast1: 0 = affirmation, -1 = control, 1= threat; contrast2: 1 = affirmation, -1 = control, 0 = threat). Thus, the first contrast directly compares the threat vs. control conditions; the second contrast directly compares the affirmation vs. control conditions. The results of both contrast analyses can be found in Table 3. Due to heteroscedastic standard deviations we used Welch's *t* statistic (Welch, 1947) to probe the contrasts and Glass's *g* coefficient (Hedges & Olkin, 1985) to estimate the respective effect size. For reasons of readability, we refrain from presenting all test statistics in the text but refer readers to Table 3 for this information.

Manipulation Checks

Our manipulation successfully affected participants' perceptions of the predominant opinion in the field in both experimental conditions: Participants in the threat (vs. control) condition less strongly believed that the majority of scientists thinks that a holistic association style has positive consequences (M_{threat} = 3.78, $M_{control}$ = 4.27), whereas the opposite was true for the affirmation vs. control contrast ($M_{affirmation}$ = 5.04). As expected, the affirmative article increased identification with the in-group ($M_{affirmation}$ = 4.13, $M_{control}$ = 3.32), whereas the threatening article did not (M_{threat} = 3.27). The opposite pattern of results emerged on the perceived threat scale: only the threatening article increased threat

perceptions (M_{threat} = 2.56, $M_{control}$ = 1.29), whereas the affirmative article did not alter threat perceptions ($M_{affirmation}$ = 1.41). These results indicate that our manipulation was successful in altering people's perception of the predominant opinion in the scientific community and also concerning the two assumed psychological process variables affecting a biased assimilation of research results – namely, the degree of threat emanating from scientific findings and the affirmative appeal of scientific findings affecting the in-group.

Main Analysis

We expected that people's evaluation of the study would be most positive in the affirmation condition and most negative in the threat condition. Investigating participants' *evaluation of the study* revealed that the threat condition differed significantly from the control condition (M_{threat} = 3.28, $M_{control}$ = 3.72) and this was also the case for the affirmation condition ($M_{affirmation}$ = 4.09). The assessment of the *competence of the author* did only differ between the threat and the control condition (M_{threat} = 4.33, $M_{control}$ = 4.77) and not between the affirmation and the control condition ($M_{affirmation}$ = 4.77). These results were also mirrored in participants' assessment of the *reputation of the author* within the scientific community and were only affected by the threatening article (M_{threat} = 3.31, $M_{control}$ = 3.74), whereas the affirming article did not alter reputation assessments ($M_{affirmation}$ = 3.92).

Concerning typicality perceptions, a similar pattern emerged: *directly assessed typicality of the author* differed between the threat and control condition (M_{threat} = -0.28, $M_{control}$ = 0.08), but not between the affirmation and control condition ($M_{affirmation}$ = 0.23). This was also the case for *typicality of the author's opinion* ($M_{affirmation}$ = 0.23, $M_{control}$ = 0.08, M_{threat} = -0.28) and for *indirectly assessed typicality of the author* (M_{threat} = -0.39, $M_{control}$ = 0.12, $M_{affirmation}$ = 0.31). Notably, no reliable differences between conditions were found for *homogeneity of the scientific community* (M_{threat} = 3.24, $M_{control}$ = 3.57, $M_{affirmation}$ = 3.20).

Discussion

The present research investigated the effects of social identity-affirming versus threatening scientific findings on perceptions of scientists and the scientific community. Participants read a threatening, an affirming, or a neutral study, evaluated the study, and assessed the competence, reputability, and typicality of its author and the homogeneity of the respective scientific community. Participants who read the threatening study perceived the author to be less competent, less reputable, and less typical for the scientific community, but they did not perceive the scientific community as more homogeneous than participants who read the neutral study. Furthermore, they evaluated the study more negatively. Surprisingly, reading an affirming study affected neither author- nor

community-related perceptions: social identity-affirming research findings only led to more positive evaluations of the study. Thus, concerning the effects of social identity-threatening research findings, our results favor the subtyping hypothesis, which suggests that researchers publishing threatening research are not seen as prototypical members of the scientific community. However, concerning affirming research findings, our results favor the homogeneity hypothesis, which assumed no effect on homogeneity and typicality perceptions. In general, our findings corroborate the notion that social identity threat triggers a motivated reception *and* perception of science and scientists – that is, people refrain from acknowledging the scientific community as a threatening homogeneous out-group and rather perceive the evidence and its researchers as a minority voice.

We derived our predictions from social identity theory and its central premise that people are motivated to maintain a positive identity. Although we did not directly test whether identity concerns are the motivational basis for the effects we found, our data allow an indirect investigation of this premise. In fact, one could have expected that a social identity threat leads to a decreased identification (see Owuamalam & Zagefka, 2011), but in our study social identification in the threat condition did not differ from social identification in the control condition (only the affirmation condition led to an increased identification). Subtyping threatening researchers as unscientific and disreputable may

constitute an effective identity protection strategy buffering the social self-concept from negative implications. Thus, interpreting our results along this line, subtyping research may indeed be functional for maintaining a positive social identity.

Another point worth discussing is the role of typicality in our study. One could argue that typicality perceptions mediate the effect of a social identity threat on science evaluations. Even though the design of our study does not allow for a direct investigation of this hypothesis (we neither manipulated typicality perceptions nor assessed typicality before the evaluative measures), typicality perceptions and evaluation of the study correlated significantly with participants' evaluation of the study ($.33 \leq r\text{s} \leq .51$). Taking research on source credibility into consideration, this line of research shows that when people perceive somebody as an expert they are also more likely to trust his/her assessments (Chaiken & Maheswaran, 1994). Thus, one could cautiously interpret these correlations as indicating a mediating effect of typicality: the more strongly laypersons perceive researchers as prototypical scientists and, therefore, trustworthy and knowledgeable, the more positively they should evaluate their research. To test this reasoning with our data, we additionally analyzed the indirect effect of the threat (vs. control) condition on evaluation via typicality perceptions by inspecting the bias-corrected 95% confidence intervals obtained by bootstrapping using Hayes' (2008) PROCESS macro

(10,000 resamples). Concerning the direct measures of typicality, both indirect effects were significant at the .05 level and only the indirect effect via the indirect measure failed to reach significance. This offers tentative support for the reasoning that typicality perceptions might be a mediator in explaining the effect of threatening research on science evaluations. However, since a reversed causality cannot be ruled out, future research should investigate whether typicality perceptions truly mediate the effect of social identity threat on evaluations by experimentally manipulating typicality.

Limitations of the Present Research

Our results generally support the notion that researchers publishing threatening scientific findings are perceived as atypical and are devalued. However, one might argue that the external validity of our study was limited. First, minimal group paradigms have often been criticized for lacking ecological validity (e.g., Rabbie & Schot, 1990). This is also true for our study, since participants only had a very limited sense about what it *means* to be a member of the group they were artificially assigned to. However, this is also advantageous since it allowed us to investigate the unbiased effect of group membership per se on science evaluation. Extending this argument, effects found in a minimal group paradigm may even be more generalizable compared to effects found in natural group settings, precisely because minimal group effects are not confounded with group specifics

inherently connected to natural groups (cf. Diehl, 1990).

Second, since we only tested university students, our sample is not necessarily representative for a general population. Undergraduate students might be more confident to evaluate research endeavors negatively compared to less educated laypersons. However, our results replicate earlier findings from real group settings (Nauroth et al., 2014, 2015), which also demonstrated similar biasing effects in other populations. Furthermore, our predictions are based on well-established findings from group perception research, which have been shown to be applicable to a wide array of populations (Abrams & Hogg, 1999). Nonetheless, future studies could recruit participants from a more heterogeneous population in order to test the replicability of our findings.

Implications for Science Communication Research and Citizen Science

Our findings have immediate implications for research on a public engagement with science: they offer a theoretical explanation for why researchers are sometimes publicly decried as being unscientific. Whenever scientific findings have negative implications for a group, its members might perceive and evaluate the respective researchers and the findings strategically in order to maintain a positive social identity. The consequences of this motivated science reception can be profoundly negative when attitudes and perceptions turn into action against science (Lewandowsky et al., 2012). Laypersons perceiving researchers

who published threatening research results as atypical for the community may not only attack the research itself but might also be tempted to publically decry these researchers personally. Unfortunately, personal attacks on scientists happen quite often in the context of socio-scientific debates, particularly on the Internet (Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014). For instance, a YouTube video produced by a prominent researcher on the effects of violent video games was severely criticized by many users attacking the author's research, his scientific reputation, and offended him personally by posting negative and uncivil comments (see Nauroth et al., 2015).

Moreover, our results add further evidence to the growing body of literature questioning the validity of the deficit model in science communication according to which people's attitudes toward science are mainly determined by their knowledge about science (Sturgis & Allum, 2004). We demonstrated that social identity concerns profoundly influence laypersons' perceptions and evaluations of scientific results regardless of laypersons' knowledge. However, our results also question whether involving laypersons in policy decision processes based upon scientific evidence is reasonable in all socio-scientific issues. Particularly when the scientific evidence has potential negative consequences for social groups, our research suggests that laypersons may be prone to bias based upon their social affiliations. For example, if regular video game players were involved in decision-

making processes concerning potential sales restrictions of violent video games, they would be likely to perceive scientific evidence demonstrating detrimental effects of violent video games as shoddy and the respective researchers as disreputable (Greitemeyer, 2014; Nauroth et al., 2014, 2015).

Conclusion

On a theoretical level, our research contributed to the literature in the domains of science communication and group perception. Science communication has just begun to explicitly include and investigate group influences on science reception (Postmes, 2015). Likewise, social identity models can be tested and refined by applying them to science reception phenomena (Bliuc et al., in press; Morton et al., 2006; Nauroth et al., 2014, 2015). Against this background, our research demonstrates the importance of considering social and group influences on laypersons' science reception. On a practical level, our research shows that science reception is affected by group identities and that this influence spans from negatively biased evaluations to distorted perceptions of scientists. Furthermore, it questions whether laypersons participation in science-based policy decision-making is advisable in all instances.

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Footnotes

[1] e.g., http://experiment.com/ (Retrieved November 28, 2014)

[2] After completing the comprehension checks, participants were asked to comment on the article by writing into one of two text boxes labeled as "PRO comment" and "CONTRA comment." Participants could only write either a "pro" (positive) or a "contra" (negative) comment. One could have hypothesized that participants in the affirmation condition were more likely to write a positive comment than participants in the control condition and that they do so less often in the threat condition. In line with this hypothesis, most positive comments were written in the affirmation condition (64%), followed by the control condition (57%), and the fewest positive comments were written in the threat condition (49%). Even though this pattern is consistent with our expectations, it failed to reach statistical significance, $\chi^2(2) = 2.29$, $p = .32$. Since we based our power analysis on continuous outcomes, our study may have been underpowered to detect an effect on a dichotomous variable. We therefore refrain from interpreting this result here.

[3] When these 22 participants were included in the analysis, the overall pattern of results remained the same. Only identification did not differ between the affirming and control condition, $t_{\text{contrast1}}(104.69) = 1.84$, $p_{\text{contrast1}} = .07$, and homogeneity perceptions were decreased in the affirming compared to the control condition, $t_{\text{contrast1}}(101.38) = 2.12$,

$p_{\text{contrast1}} = .04$ ($M_{\text{affirmation}} = 3.15$, $M_{\text{control}} = 3.57$).

Table 1: Descriptive Statistics

Variable	*M* (*SD*)		
	Threat	Control	Affirmation
Predominant opinion in scientific community	3.78 (1.03)	4.27 (0.66)	5.04 (0.93)
Identification	3.27 (1.62)	3.32 (1.64)	4.13 (1.47)
Threat	2.56 (1.31)	1.29 (0.53)	1.41 (0.65)
Evaluation of the study	3.28 (0.91)	3.72 (0.80)	4.09 (0.94)
Competence of the author	4.33 (0.93)	4.77 (0.77)	4.77 (0.88)
Reputation of the author	3.31 (0.86)	3.74 (0.91)	3.92 (0.82)
Direct measures of typicality:			
Typicality of author	-0.28 (0.81)	0.08 (0.79)	0.23 (0.82)
Typicality of author's opinion	-0.46 (0.70)	0.27 (0.75)	0.23 (0.65)
Indirect measures of typicality:			
Typicality of author	-0.39 (1.35)	0.12 (0.66)	0.31 (0.67)
Homogeneity of scientific community	3.24 (1.09)	3.57 (0.87)	3.20 (1.19)

Notes: $N = 138$.

Table 2: Correlations between Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Predominant opinion in scientific community (1)	1.00									
Identification (2)	.17*	1.00								
Threat (3)	-.20*	-.04	1.00							
Evaluation of the study (4)	.23**	.26**	-.26**	1.00						
Competence of the author (5)	.23**	.13	-.23**	.69***	1.00					
Reputation of the author (6)	.21*	.26**	-.07	.50***	.38***	1.00				
Direct measures of typicality:										
Typicality of author (7)	.11	.15	-.09	.39***	.34***	.42***	1.00			
Typicality of author's opinion (8)	.12	.08	-.30***	.51***	.42***	.51***	.65***	1.00		
Indirect measures of typicality:										
Typicality of author (9)	.14	.01	-.36***	.33***	.28**	.30***	.32***	.35***	1.00	
Homogeneity of scientific community (10)	.00	-.16	-.08	-.23**	-.14	-.05	-.05	-.02	-.11	1.00

Notes: $N = 138$. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 3: Results of the Contrast Analysis

Variable	Contrast1 (Threat vs. Control)				Contrast2 (Affirmation vs. Control)			
	t	*p*	*g*	95% CI	*t*	*p*	*g*	95% CI
Predominant opinion in scientific community	**2.81**	**.006**	**-0.75**	[-1.19, -0.31]	**4.53**	**<.001**	**1.17**	[0.69, 1.64]
Identification	0.16	.87	-0.03	[-0.44, 0.38]	**2.47**	**.02**	**0.50**	[0.07, 0.91]
Threat	**6.25**	**<.001**	**2.41**	[1.76, 3.06]	0.96	.34	0.23	[-0.18, 0.64]
Evaluation of the study	**2.48**	**.02**	**-0.55**	[-0.97, -0.12]	**2.03**	**.05**	**0.47**	[0.04, 0.89]
Competence of the author	**2.48**	**.02**	**-0.57**	[-0.99, -0.14]	0.03	.98	0.01	[-0.41, 0.42]
Reputation of the author	**2.35**	**.02**	**-0.48**	[-0.89, -0.06]	0.94	.35	0.19	[-0.23, 0.61]
Direct measures of typicality:								
Typicality of author	**2.20**	**.03**	**-0.46**	[-0.88, -0.04]	0.84	.35	0.18	[-0.24, 0.60]
Typicality of author's opinion	**4.85**	**<.001**	**-0.98**	[-1.43, -0.51]	0.31	.76	-0.06	[-0.48, 0.36]
Indirect measures of typicality:								
Typicality of author	**2.35**	**.02**	**-0.78**	[-1.22, -0.34]	1.35	.36	0.29	[-0.13, 0.71]
Homogeneity of scientific community	1.68	.10	-0.37	[-0.78, 0.05]	1.59	.12	-0.42	[-0.84, 0.01]

Notes: $N = 138$. *T*-values based upon Welch's *t*-test. Bold-type contrasts are significant at $p < .05$. Positive (negative) g-values indicate a higher (lower) mean in the experimental (i.e., threat and affirmation) compared to the control condition.

6 Final Discussion

Research on science communication has grown during recent years and identified many factors that influence people's attitudes toward science. The present research set out to extend this research conceptually by demonstrating that social identity processes explain a wide range of science rejection phenomena. Social identity theory accurately predicted laypersons' reactions to social identity threatening research concerning laypersons' evaluation of a scientific endeavor, online commenting behavior and perceptions of scientists. Seven studies consistently showed that when research findings have negative implications for laypersons' social identity, laypersons are prone to react to these findings in a defensive-hostile manner. In sum, they show that when research findings have negative implications for laypersons' social identities, laypersons (a) evaluate the respective research negatively, (b) act against this research by writing a science-discrediting online comment, and (c) perceive the publishing researchers as incompetent, disreputable, and untypical. Importantly, these effects are explained by group-based processes (i.e., perceived stigmatization and social identity protection) and independent form personal identity alternative explanations. Elaborating the last point, three results are particularly noteworthy. First, belief and a behavioral preference inconsistency effects were separable from social identity effects (Manuscript #1). Second, even in the absence of prior attitudes or beliefs (by experimentally eliminating these variables in a minimal group design), threatening research results still elicited biased evaluations and perceptions (Manuscript #3). Third, as predicted by social identity theory, a collective affirmation was particularly effective in reducing science-discrediting comments made by strongly identified laypersons, whereas a self-affirmation was not (Manuscript #2). In sum, the underlying theoretical framework for a group-based science rejection developed in the Introduction explains laypersons' reactions to group relevant findings comprehensively and rather parsimoniously.

In the following, I first mirror the general results of the present research on the conceptual basis derived in the Introduction by focusing on open questions and potential

limitations and then discuss future research directions. I end with discussing practical implications of a group-based science rejection for communicating science and provide some suggestions for how to improve the public engagement with science more generally.

6.1 Open Questions and Limitations of the Present Research

Even though the present thesis aimed to provide a comprehensive theoretical and empirical account for the notion of a group-based science rejection, both theoretically and empirically the present research faces open questions or has potential limitations. In the following, I will discuss three potential limitations of the current set of studies. First, the theoretical interrelatedness of the three major outcome variables may be underdeveloped. Second, although it was theoretically assumed that merely being a group member is a precondition for a group-based science rejection, only the minority of conducted studies found an unconditional effect of threatening science on group members' science rejection. Finally, I discuss whether the situational preconditions for observing a group-based science rejection are so restrictive that it may be practically negligible.

6.1.1 Interrelatedness of Perceptions, Evaluations, and Behaviors

It is plausible to assume that the three main dependent variables of the current research are interrelated. Negative evaluations correlated highly with science-discrediting commenting behavior ($.52 < rs < .63$) and moderately with typicality perceptions of scientists ($-.39 < rs < -.32$). These moderate to high correlations indicate that when people feel threatened in an important aspect of their social identity they simultaneously perceive researchers as untypical, evaluate the research negatively, and react in a science-discrediting manner. Even though social identity threat may be the common cause for altered perceptions, biased evaluations, and discrediting behavior, the precise conceptual interrelatedness of the outcomes remains unclear.

Social identity theory does not offer clear predictions how these variables may be interrelated. Nonetheless, research in the tradition of social identity theory mostly assumed that perceptions precede attitudes and attitudes and perceptions precede behavior (e.g., Brewer & Kramer, 1985). This assumption is intuitively appealing and, on a general level, also empirically supported (Glasman & Albarracín, 2006). Applied to laypersons' reactions to threatening scientific findings, one might argue that perceptions about scientists form the basis for attitudes toward their studies and attitudes and perceptions form the basis for science-discrediting behavior. However, in the specific case, this reasoning may be premature – both theoretically and empirically. Theoretically, the relationship between perceptions, evaluations and behavior may also be reverse or at least bidirectional. For instance, laypersons may evaluate a study as methodologically flawed and infer from this evaluation that the authors are neither competent nor typical scientists. Likewise, behaviors may precede evaluations when people communicate to an audience, whose attitudes they know ("saying-is-believing"; see e.g., Higgins & Rholes, 1978): when people communicate to an audience of whom they think that it holds negative attitudes against research confirming the violent-games-effect hypothesis (e.g., gamers), communicators' attitudes shift in the direction of the presumed attitudes of the audience, that is, communicators attitudes would become more negative. Thus, there are also theoretical arguments for reverse causal pathways for the observed perception-evaluation and evaluation-behavior correlations.

Moreover, despite the moderate and high correlations between the outcomes, some empirical findings of the current research challenge the assumption of direct causal relationships between the outcomes. First, the results of Study 6 do not support a causal link between science-discrediting behavior and negative evaluations: collectively affirming strong identifiers reduced science-discrediting behavior but not their negative evaluations. This implies that the mechanism triggered by social identity threat underlying science-discrediting behavior is (at least partly) different from the mechanism underlying biased evaluations.

However, these diverging effects on commenting behavior and evaluations should be interpreted cautiously since the affirmation effect could simply have been short-lived. If this was the case and since evaluations were assessed after commenting behavior in Study 6, it might be an order effect that commenting behavior was affected by the collective affirmation while negative evaluations were not. Nonetheless, except for the correlation between evaluations and behavior, as a prerequisite for a causal relationship, there is no firm empirical evidence in the current set of studies favoring a direct causal relation between these two outcomes. Second, concerning the perception-evaluation link, Study 7 also questions a firm causal relationship between laypersons' perceptions of researchers and study evaluations: whereas threatening research findings affected evaluations and perceptions, affirming research findings only affected evaluations. This pattern suggests that one does not (always) cause the other, regardless of the supposed directionality of the relationship.

Summing up, direct causal relationships between the three outcomes are theoretically reasonable, but the present empirical evidence and theoretical considerations caution against simple conclusions. Most probably, perceptions of scientists, study evaluations, and discrediting behavior are to a certain degree causally connected but at the same time determined by unique dispositional and situational factors. The directionality of the causal relationships might also depend on the context in which laypersons' science reception takes place (e.g., whether audience communication is anticipated or not). Disentangling the relationship between these variables is therefore an empirical question for future research.

6.1.2 The Role of Social Identification

Even though all studies consistently showed an effect of threatening research findings on laypersons' evaluation, this effect was mainly present in strongly identified group members. Only two (Studies 3 and 7) of the five studies (Studies 2, 3, 4, 5, and 7) that allow a direct comparison of the effects of threatening vs. non-threatening research on evaluations

found an unconditional effect (a "main effect" statistically speaking). In the remaining subset (Studies 2, 4, and 5), threatening studies only conditionally affected evaluations depending on the group members' level of identification: only strongly identified group members showed a biased evaluation. This raises doubts whether group membership per se is sufficient for a group-based science rejection. Alternatively, one could argue that only strongly identified group members show group-based science rejection effects. However, reducing the explanatory power of the present thesis to strongly identified group members only may also be too restrictive.

In social identity theory, in-group identification is a crucial marker for the importance of the group for people's self-concept (Tajfel & Turner, 1986) and an important moderator for social identity effects to occur (Ashmore, Deaux, & McLaughlin-Volpe, 2004). However, there is no theoretical definition for the level of identification needed in order to reliably observe social identity effects and this complicates definite a priori predictions. Research on social identity theory tried to avoid this problem by adopting a purely operationalized approach, which was also the strategy in the present research. That is, by measuring identification, group-members are divided into "weak" and "strong" identifiers (based on either a median split or a deviation from the mean by +/- 1 *SD*). This classification has the caveat of being highly artificial because it purely depends on the specific study sample characteristics: "strong identifiers" in one study may be "weak identifiers" in another study, depending on the average identification of the participants.

Applying these considerations on the current set of studies, average identification scores varied considerably across studies (from 2.28 to 3.70 on a scale ranging from 1 to 6[1]). This variance in identification may also account for the diverging results concerning the conditionality of threatening vs. non-threatening research affecting evaluations. Whereas in

[1] Note that the employed items were slightly different across studies.

studies yielding an unconditional effect of threatening research, average identification was, compared to the scale midpoint (of 3.5), of medium size (Study 3: 3.70; Study 7: 3.57), average identification in studies yielding only a conditional effect of threatening research was rather low (Study 2: 2.81; Study 4: 2.63; Study 5: 2.87). This also holds when comparing these means with identification means found in other research with the similar scales: Postmes, Haslam, and Jans (2013), found an average identification on their single-item measure of social identification across several different groups of 3.80 and van Zomeren, Postmes, and Spears (2008) of 3.41 (both means were transformed to be comparable to a six-point response scale). Comparing these means to the means observed in the current studies, participants in Studies 3 and 7 rather showed a medium level of identification, whereas participants in Studies 2, 4, and 5 showed a weak identification.

This comparison highlights that, in relative terms, "weak"-identifiers in Studies 2, 4, and 5 were "very weak"-identifiers in absolute terms and relative "strong"-identifiers were absolutely speaking rather "medium"-identifiers. Conversely, identification of relative "weak"-identifiers in Studies 3 and 7 actually resembled weak identification in absolute terms. Thus, the current evidence indicates that medium identified group members indeed show a group-based science rejection, but only very weakly identified group members do not. Reinterpreting the present studies from this perspective, a group-based science rejection seems to be (on average) the default mode of group members when encountering social identity threatening research results. Nevertheless, the present evidence unequivocally demonstrates that the more strongly group members identify with their in-group, the more likely they are to reject threatening scientific findings. This empirically confirms the theoretical assumption of social identity theory that the more important a group membership is for a given individual, the more likely s/he is to act based upon this group membership when confronted with a social identity threat.

6.1.3 Preconditions for Observing a Group-based Science Rejection

One could argue that the explanatory power of the present research may be severely limited theoretically: the phenomenon of a group-based science rejection may be negligible because it is only applicable to rare instances (e.g., violent video games research and video game players). By definition, a group-based science rejection only occurs when research findings are group-relevant and this may only apply to a small fraction of the scientific findings that face considerable public resistance. For instance, research on climate change faces considerable public opposition, but apparently does not have any evaluative implications for social or societal groups. However, this concern is shortsighted because laypersons can even spontaneously categorize themselves according to whether they trust in a certain scientific finding or whether they do not trust in a certain scientific finding. This spontaneous social categorization should be sufficient for social identity processes to occur (cf. Borzikowsky, 2013). Recently, Bliuc et al. (in press) demonstrated that simply believing or denying the existence of climate change indeed creates the basis for a shared group identity. More precisely, by simply self-describing as “skeptics” or “believers” people already showed signs typically found in intergroup conflicts. Believers and skeptics alike felt angry about the respective out-group, identified to a varying degree with their in-group and believed in the efficacy of collective actions taking by their in-group. Bliuc and colleagues concluded that the dynamics of the climate change debate might be best interpreted as a socio-political conflict between these groups based upon their shared social identities.

In conclusion, the explanatory power of the present theoretical framework should go beyond instances in which scientific findings affect existent groups. By simply categorizing as believing in the validity of a scientific finding compared to not believing in its validity should create the basis for the proposed social identity mechanisms.

6.2 Future Directions

The previous section already discussed some issues on which future research is desirable – particularly in order to clarify potential limitations of the present work. In contrast, the following section presents two general research directions that may fruitfully and more comprehensively extend the current line of research. The first addresses potential cognitive mechanisms of the present findings whereas the second addresses further downstream behavioral consequences.

6.2.1 Cognitive Mechanisms of Processing Threatening Information

A promising direction for future research is to investigate early cognitive mechanisms responsible for processing social identity threatening information. Laypersons attention, comprehension and memory processes might already be altered upon detecting social identity threatening information. Most social-cognitive research on the processing of social identity threats only addressed self-report outcomes (like evaluations; e.g., Cadinu & Cerchioni, 2001; De Hoog, 2013; Dietz-Uhler, 1999; see also 1.4.1) and only recent research began explicitly investigating how social identity threats affect basic cognitive processes. For instance, Dalton and Huang (2014) demonstrated that individuals forget social identity threatening marketing promotions more often than non-threatening promotions and a social identity affirmation eliminated this effect. This implies that being motivated to restore a positive sense of one's social identity after being confronted with a social identity threat already alters basic memory processes. Advancing this line of research might therefore shed light on how basic psychological needs – like identity protection – are interlocked with basic cognitive processes consequently affecting group members' attention, comprehension, and memory.

A promising starting point for this line of research is to speculate about the earliest point in information processing in which threatening information can be processed differently than non-threatening information. Stimulated by laypersons' science reception as the

explanandum and thereby, for the time being, restricting this question to linguistic information, threatening linguistic information can only alter information processing after the threat was detected. More precisely, our cognitive system has to decode and comprehend the content of a message before an inconsistency between goals (e.g., having a positive social identity) and the information (e.g., "social identity is not positive") can be detected (Gilbert, Krull, & Malone, 1990). Put differently, our cognitive system has to validate the content of a message against our belief system and psychological goals in order to influence downstream cognitive and psychological processes. Recent research indicates, however, that comprehension and validation of linguistic information are closely intertwined and may actually happen in parallel (Singer, 2013). For example, in an experiment by Richter, Schroeder, and Wöhrmann (2009), participants with strong prior background knowledge rejected false assertion as efficiently as they verified true assertions and this even under additional cognitive load. Richter et al. (2009) argued that an automatic validation process protects mental representations from being contaminated by false and inaccurate information, thereby enabling a fast and efficient rejection of subjectively false assertions. Similar results with alternative paradigms by Isberner and Richter (2013, 2014) indicate that validation is indeed a routine, non-strategic process – at least concerning factual knowledge. To date, no research exists that indicates whether these (or other, similar) processes may also protect mental representations of one's identity being contaminated with threatening information.

Building upon this research on text comprehension, an interesting new line of research arises when one assumes that similar processes exist that detect identity relevant discrepancies, that is, identity threats, and prevent such information to be included in identity-related mental representations. If the effects of the present research were based on such an automatic, non-strategic, identity protection process, group members should reject threatening information (e.g., "Video game players are aggressive") as quickly and automatically as objectively implausible information (e.g., "Video game players people do not have to breathe

in order to live"). Notably, such a validation process must not be limited to social identity related threats, but should rather be generally directed at detecting any discrepancies between message content and individuals' mental representations in general – including the belief system, identity and factual knowledge. If a basic identity-protection processes existed, future research questions would be manifold. One could ask whether such identity-protection processes also alter the way people read identity-threatening texts. This research question could easily be studied by eye-tracking people's gaze position when reading identity-threatening vs. non-threatening texts. Another interesting question would be whether identity affirmations temporarily suspend even such basic identity-protection processes. This line of research may therefore provide a basic cognitive understanding of identity-protection processes.

6.2.2 Investigating Long-Term Consequences of Group-based Science Rejection

The present research focused on quickly emerging responses to social identity threatening research. Another important future research question is which long-term consequences – if any – could be expected from being confronted with threatening research. Recently, Jonas et al. (2014) proposed a model integrating many social-psychological threat theories in the "general process model of threat and defense", which may guide future research endeavors. The model focuses on individuals' reaction after experiencing any kind of psychological threat and excludes etiological factors leading to the emergence of threat. Jonas et al.'s model highlights an often neglected factor in social-psychological threat research: time. The model postulates that the quality of response to a threat changes over the course of time, more precisely within a few minutes after the threat. Immediately after people encounter threatening information, proximal defenses are activated. These are avoidance-oriented reactions motivated by anxiety. Proximal defenses are for example, biased information processing aimed at minimizing threat-related thoughts or evaluating threatening stimuli

exaggeratedly negative (Jonas et al., 2014, pp. 239–241). The biased evaluations of threatening research findings observed in the present research fall into this category.

A few minutes after encountering threatening information, the avoidance motivation is downregulated and an approach-oriented motivation that triggers distal defenses prevails. Distal defenses are manifold in their appearance, but share the common motivational feature of muting avoidance motivation and relieving anxiety. Approach-oriented distal reactions to threatening scientific information would be to become more strongly convinced of the initial belief contradicted by the threatening information (as observed by Greitemeyer, 2014). Concerning social identity threats emanating from science, approach-oriented reactions could be strengthening one's identification with the in-group and/or investing more time and resources in common group activities, like classical collective actions.

To date, collective action research did not raise the question whether the quality of collective actions in response to social identity threats might change as a function of time. The reason for this neglect is simple: most classical collective actions (i.e., writing a letter to a politician, participating in a public discussion, or protesting on the street) require preparation or organization and are therefore, in Jonas et al.'s sense, non-spontaneous. In other words, classical (offline) collective actions are not performed immediately after a social identity threat was encountered. In the terminology of Jonas et al.'s model, classical collective actions can be conceptualized as a distal defense and the same holds true for high-threshold online collective actions (e.g., maintaining a protest site). However, nowadays the Internet also offers many possibilities to participate in and even instigate collective actions immediately after feeling threatened: group members can immediately write a derogative online comment against the perceived source of a threat. Thus, low-threshold collective actions like writing a derogative comment may be conceptualized as proximal defenses (cf. Van Laer & Van Aelst, 2010).

According to this reasoning, one could expect that high-threshold collective actions may be long-term consequence of being confronted with threatening scientific evidence. But what could such high-threshold collective action in the realm of science communication look like? High-threshold online collective actions in the science reception domain could be collecting and reviewing research findings which contradict the originally threatening research finding and making these reviews publicly available (e.g., on Wikipedia or on a blog). In the violent video games debate (but concerning climate change as well, see Lewandowsky, Cook, Oberauer, & Marriott, 2013), numerous websites and blogs of this kind exist: run by passionate video game players, they publish own summaries of the current state of research on violent video games and come to the conclusion that the evidence does not indicate any practically relevant harmful effects of violent video games.[2] This may be particularly worrisome, since blogs have been shown to be perceived as highly credible sources (Johnson & Kaye, 2004). The persuading effect of blogs and similar website on other readers to also dismiss group-threatening research findings may therefore be considerably larger than the persuading effect of online comments. Thus, investigating whether threatening scientific evidence can also trigger high-threshold online collective action is of high interest for science communication.

In sum, the empirical investigation of long-term consequences of identity threats is an important line of future research for laypersons' science rejection and research on collective action in general. In this regard, the general model of threat and defense (Jonas et al., 2014) may be fruitfully connected to recent research on different forms of online collective action (Van Laer & Van Aelst, 2010).

[2] e.g., http://stigma-videospiele.de, http://www.psychologyofgames.com

6.3 Consequences for Science Communication and Engagement

The present research has both theoretical and practical implications for science communication. Theoretically, it stresses the need for considering group processes when investigating laypersons' reaction to science. From a practical perspective, recommendations can be derived regarding how threatening science should (not) be communicated. In the following section, I will demonstrate how the present research can impregnate science communication research and derive recommendations for communicating potentially threatening scientific results.

6.3.1 Generalized Negative Science Attitudes

The present research might also help to shed light on how generalized negative attitudes against specific science domains and science in general can emerge. Recently, Nisbet and Markowitz (2014) identified four segments in the US public, holding different beliefs about science and its impact on society ("science-related schemas"): (1) scientific optimists, strongly believing in science as a source of societal progress and being highly supportive of scientific advances; (2) scientific pessimists, having reservations about the moral boundaries potentially crossed by science and being rather opposed to scientific advancements; (3) conflicted, viewing science in optimistic and pessimistic terms; and (4) disengaged, lacking a well-informed mental model for how science may impact society. In their study, these science-related schemas predicted support for stem cell research in addition to, for example, political orientation, religious beliefs, and self-rated scientific knowledge. Even though Nisbet and Markovitz (2014) only demonstrated the importance of these schemas in the domain of stem cell research, it is reasonable to assume that these science-related schemas are also important in other science domains.

This raises the important question how such generalized science-related attitudes or schemas develop. A first hint can be gained by reviewing studies that investigated the

formation of negative attitudes against entire research questions or fields of research. To date, only Munro's (2010) study touched upon this question. He showed that being confronted with belief-inconsistent scientific findings in one domain leads laypersons to question whether an entire set of other unrelated questions can be investigated scientifically at all. This demonstrates that laypersons readily dismiss the scientific method fundamentally when findings obtained with this method collide with laypersons' personal belief system.

These results are complemented by Study 3 of the present research: gamers generalized their negative evaluations of one specific study to the entire field of video games research. This indicates that social identity threatening scientific findings may be another trigger for a generalization process to occur. One could speculate that the functionality of negative science attitudes toward entire, potentially threatening research areas is to facilitate defensive reactions in future confrontations with similar research. In this sense, generalized negative attitudes may act as a stereotype guiding future science-directed reactions. For instance, gamers' negative attitudes toward the entire field of video game research may be automatically activated whenever gamers read something about "research on the effects of video games" in order to facilitate coping with potential negative consequences for their social identity.

Similarly, one could argue that repeated identity-threatening and/or belief-inconsistent experiences with scientific findings from diverse disciplines may lead to generalized negative science-related schemas. For instance, people holding very conservative and religious beliefs see themselves repeatedly confronted with research threatening their belief system and identity. Research on evolution (Jelen & Lockett, 2014), anthropogenic climate change (Kahan et al., 2012; Kahan, Jenkins-Smith, & Braman, 2011), stem cell research (Ho, Brossard, & Scheufele, 2008), nanotechnology (Scheufele, Corley, Shih, Dalrymple, & Ho, 2009), and on the cognitive processes of conservatives (Jost, Glaser, Kruglanski, & Sulloway,

2003) may threaten these people's identity as being conservative and religious. Being repeatedly confronted with threatening science may therefore lead to chronically accessible negative attitudes toward science in general. This hypothesis is indirectly supported by research on stereotype formation demonstrating that negative experiences with out-group members are more readily generalized than positive experiences (Barlow et al., 2012; Stark, Flache, & Veenstra, 2013). Identifying the conditions responsible for the development of generalized negative attitudes against science is of great importance for science: it may provide the basis for designing prevention strategies that aim at avoiding their formation in the first place.

6.3.2 Practical Implications for Communicating Scientific Evidence

Nisbet and Markowitz (2014) also stressed that identifying clusters of laypersons with similar science-related attitudes may help to improve science communication activities. By designing communication campaigns precisely targeting one of these clusters, science communication can become more successful in dispelling misconceptions about specific scientific endeavors (for a similar argument see also Einsiedel, 2007). However, the current research suggests that the interplay between audience characteristics and characteristics of the scientific findings is crucial in anticipating public attitudes: Science communicators should be aware of the threatening potential of scientific findings for specific social and societal groups.

In order to prevent a group-based science rejection, science communicators should analyze the findings they want to communicate concerning their threatening potential for laypersons when planning their communication strategy. In the following, four recommendations are derived from the present and general research on group processes for how science communicators could try to avoid potential science-discrediting effects triggered by social identity threats.

Avoid intergroup terminology. In the case of scientific findings threatening laypersons' social identity, communicators should avoid using statements creating an intergroup situation. According to Tajfel and Turner (1979, 1986) an intergroup situation is a precondition for social identity effects and using language constructing an intergroup situation may facilitate the processes described in the present research (see also Postmes, Gordijn, et al., 2013). If possible, a message should not make explicit reference to a social or societal group potentially affected by the research (Postmes, 2015). For instance, when communicating harmful effects of violent games to the public a statement like "researchers showed that gamers playing violent video games are at risk for becoming more aggressive" implicitly creates an intergroup situation of "researchers" versus "gamers." Instead, a statement like, for example, "research on violent video games indicates that violent video games can increase aggressiveness" avoids explicit intergroup language and should be less likely to trigger group-based motivated science reception processes.

Communicate identity valuing. Besides the negative effect of threatening research findings on laypersons' science reception, the empirical evidence also indicated a potential remedy: after affirming an alternative aspect of participants' social identity, participants were less likely to post a science-discrediting comment (see Study 6). Transferring this result to practically communicating science, messages could refer to other results being positive for laypersons' social identity. However, this strategy has to be used cautiously, since communicators balance on a fine line. On the one hand, referring to identity-affirming evidence might prevent defensive reactions of laypersons. On the other hand, it might also invalidate the original research finding when the identity-affirming evidence is contradictory. Thus, communicators should use identity-affirming evidence that is complementary and not contradictory to the original evidence. For instance, when communicating harmful effects of violent video games, communicators could also refer to findings showing that playing these games in teams may buffer harmful effects (Greitemeyer, Traut-Mattausch, & Osswald, 2012)

or that playing prosocial games increase prosocial behavior (Greitemeyer & Osswald, 2010). Of course, complementary affirming scientific evidence does not always exist, but when it exists, it might be useful to ameliorate defensive responses caused by threatening implications.

Use an in-group source. People react less defensively towards persuasive messages when the source of the message is an in-group member (e.g., Cohen, 2003; Wood, 2000). Applied to communicating science, when researchers are members of a group potentially affected by their research findings, they might identify themselves as an in-group member. For instance, when researchers find negative effects of a vegetarian diet, vegetarians of the research group could communicate these findings with a reference to their own group membership.

Refer to an inclusive category. Another way of reducing defensiveness might be to refer to a social category including the researchers and the group affected by the research. For instance, communicators could emphasize that groups affected by the research and the researchers have the common interest of wanting to know about the truth concerning the validity of the research finding. This might create the basis for an abstract social categorization including both the researchers and the group members decreasing their defensive reactions (cf. Greenaway, Wright, Willingham, Reynolds, & Haslam, 2015). This reasoning is also theoretically supported by the common in-group identity model that postulates a reduction of group-based biases when a common group identity is salient (see Gaertner, Dovidio, Anastasio, Bachman, & Rust, 1993).

Even though, these recommendations might help to reduce a group-based science rejection, empirical evidence on their effectiveness is direly needed. Future research should investigate whether a group-based science rejection can indeed be reduced by altering the proposed message characteristics.

6.3.3 Consequences for the Public Engagement with Science

A major challenge for the future is to develop interventions for efficiently reducing defensiveness against scientific evidence. One proposed remedy for this problem is strengthening public's engagement with science (e.g., Hand, 2010). Motivated and interested laypersons should participate in early stages of the scientific process (Mims, 1999), scientific data collection (Brossard, Lewenstein, & Bonney, 2005), and decisions about which research project deserves public funding and which does not ("citizen science," see Irwin, 2001; Karl & Turner, 2003). Even though there is some promising evidence for its effectiveness (e.g., Bonney et al., 2009), this approach also has several drawbacks. First, involving laypersons in early research phases or in data collection is not applicable in all scientific fields and participation in science-based policy decisions requires at least an intuitive understanding of the respective scientific matters. For instance, many laypersons have problems understanding the basic premises of quantum mechanics even after appropriate instruction (Olsen, 2002). Without even an intuitive understanding (and even with only an intuitive understanding), it is questionable whether a layperson would be able decide which research projects should be supported or which policies should pass. Second, comprehensively implementing this approach in scientific and political processes requires considerable organizational changes of these processes. This makes a comprehensive implementation difficult if not impossible (Burns, 2007). Third, the science rejection mechanisms identified in the present thesis and related research seed doubt on the effectiveness of the participatory science approach. Involving laypersons that simply reject undesirable research findings in important science-based policy decision-making processes certainly leads to suboptimal decisions with potentially disastrous consequences for our society. For instance, when laypersons that reject evidence demonstrating anthropogenic climate change are involved in decisions about carbon emission policies, such policies might not pass with grave consequences for the world's climate.

Because of its shortcoming the citizen science approach should be supplemented by alternative approaches that are easier to implement and broadly applicable. One way would be concentrating more strongly on how to better design the communication process in order to reduce defensiveness. In line with the implications of the present thesis, this approach should concentrate on the interaction between message and audience characteristics. In order to maximize the success probability of this approach, science communication should be more strongly professionalized. Professional science communicators could fully concentrate on designing communication strategies and avoiding some of the obstacles science communication faces. Such an approach would have the benefit of being applicable to a wide array of instances and would not necessarily require changing existing structures in academia or legislation.

6.4 Conclusion

Communicating science to the public faces many obstacles and scientists and politicians both struggle with the publics' rejection of scientific evidence in important socio-scientific issues. Almost every major issue that humanity faces today has scientific components at its core: anthropogenic climate change, violence and wars, economic growth, healthcare, or environmental development. All these issues require scientific inventions and discoveries in order to be resolved. Condoning the public's science rejection in these issues will have broad and potentially disastrous consequences for our society. In order to deal with the socio-scientific challenges of our time, the public has to understand and make use of the tremendous scientific knowledge scientists have already accumulated. Successful science communication overcoming public's science rejection is the key to putting that knowledge into practice and ensuring this is a major challenge for politicians and scientists alike. The present research might have brought us one step closer to overcoming this rejection.

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7 Zusammenfassung

Unabhängig davon, ob es sich um die Reduktion von Treibhausgasen oder die Prävention von Aggression und Gewalt bei Jugendlichen handelt, basieren mögliche Lösungen für die heutigen gesellschaftlichen Probleme meist auf wissenschaftlichen Untersuchungen und Daten. Aber gerade jene wissenschaftlichen Studien, die Implikationen für wichtige gesellschaftliche Themen haben, sehen sich besonders häufig wissenschaftlichen Laien gegenübergestellt, die die Ergebnisse fundamental in Frage stellen oder sogar rigoros als ungültig ablehnen. Die vorliegende Arbeit untersucht, ob eine solch grundsätzlich ablehnende Haltung gegenüber bestimmten Forschungsergebnissen auf eine bedrohte soziale Identität zurückgeführt werden kann („group-based science rejection“). Die soziale Identität beschreibt jenen Teil unseres Selbstkonzepts, der auf unseren Gruppenmitgliedschaften basiert. Auf Basis der Sozialen Identitätstheorie (Tajfel & Turner, 1979, 1986) wird angenommen, dass wenn Forschungsergebnisse negative, evaluative Implikationen für soziale oder gesellschaftliche Gruppen haben (also eine soziale Identitätsbedrohung darstellen), Gruppenmitglieder abwertend und ablehnend auf solche Ergebnisse reagieren. Zudem wird angenommen, dass je wichtiger es Gruppenmitgliedern ist, Teil der bedrohten Gruppe zu sein (hohe Identifikation), desto stärker sollte diese Abwertung ausfallen.

Drei Manuskripte bestehend aus sieben Studien (*N*s = 347, 97, 199, 84, 655, 459 & 138) bestätigen diese Annahmen. Die Ergebnisse zeigen, dass Gruppenmitglieder wissenschaftliche Studien, von denen eine soziale Identitätsbedrohung ausgeht, im Vergleich zu nicht-bedrohlichen Studien negativer bewerten Gruppenmitglieder über solche Studien negativer kommunizieren und beide Effekte für hochidentifizierte Gruppenmitglieder besonders stark ausgeprägt sind (Manuskript #1 und #2). Zudem nehmen Gruppenmitglieder Autoren von bedrohlichen Studien als inkompetentere und untypischere Wissenschaftler wahr

als Autoren von nicht-bedrohlichen Studien (Manuskript #3). Die Ergebnisse zeigen weiterhin, dass die Abwertung bedrohlicher, wissenschaftlicher Arbeiten durch gruppenbasierte Prozesse (wie Stigmatisierungswahrnehmung und soziale Identitätsbekräftigung) erklärt werden kann. Zudem werden Alternativerklärungen, die eine Zuhilfenahme des Gruppenkonzepts nicht benötigen, ausgeschlossen (bspw. selbstaffirmationstheoretische Erklärungen [Steele, 1988] oder Konfundierungen durch Einstellungsinkonsistenzeffekte [Kunda, 1990]). Wohingegen Manuskript #1 und #2 diese Phänomene in Rahmen der Gewaltspieldebatte untersuchte, wurde in Manuskript #3 ein „Minimal Group"-Paradigma verwendet (Tajfel, 1970).

Zusammenfassend zeigen die Ergebnisse aller drei Manuskripte, dass wissenschaftliche Laien Forschungsergebnisse dann fundamental negativ bewerten und gegen solche Ergebnisse vorgehen, wenn diese bedrohlich für ihre soziale Identität sind. Die Ergebnisse haben Implikationen für die Art wie wissenschaftliche Ergebnisse an die Öffentlichkeit kommuniziert werden sollten und inwiefern eine starke Einbindung von Laien in wissenschaftsbasierte, politische Entscheidungsprozesse sinnvoll ist.

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8 Danksagung

Die Seiten 163-165 enthalten persönliche Daten und sind deshalb nicht Teil der Online-Veröffentlichung

9 Angaben zur Person

Die Seiten 163-165 enthalten persönliche Daten und sind deshalb nicht Teil der Online-Veröffentlichung.

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10 Erklärung

Ich versichere, dass ich meine Dissertation

„Group-based science rejection: How social identities shape the way we perceive, evaluate, and engage with science“

selbstständig, ohne unerlaubte Hilfe angefertigt und mich keiner anderen als der von mir ausdrücklich bezeichneten Quellen und Hilfen bedient habe.

Die Dissertation wurde in der jetzigen oder einer ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg an der Lahn, Februar 2015 Peter Nauroth

The research for this Doctoral Dissertation was conducted in the context of the DFG-funded projects “Motivated biases in the reception of scientific evidence: The role of social identification and moral values” and “Motivated biases in the reception of scientific evidence (II): mechanisms and consequences” (both headed by Prof. Dr. Mario Gollwitzer) within the Priority Program 1409 “Science and the general public: Understanding fragile and conflicting scientific evidence.”

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